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VOL. XV FASC. 6 31: X 1934 N:o 88

ON SILICOSIS IN PORCELAIN WORKERS, FROM THE ROENTGENOLOGICAL AND SOME CLINICAL POINTS OF VIEW[1]

by

P. Flemming Møller

(Tabula LXXVI—LXXX)

The series of investigations instituted by the Directorate for Inspection of Factories and Workshops concerning the occurrence of silicosis in dust-producing industries in Denmark has during the years 1932—1933 included an investigation into the occurrence of the disease in the porcelain industry, and at a meeting of the Society of Medicine Dr. S. V. GUDJONSSON has given an account of the results from the point of view of industrial hygiene (1).

The presence of silicosis can be positively ascertained only by roentgen examination, and it was therefore endeavoured to have such an examination made, as far as possible, of all the workers in the five porcelain works of the country, the total number of whom was 859. In the end only 798 were roentgenographed, however; because it was decided not to include in the investigation those who had been engaged in the work for less than three years, and some others refused to be roentgenographed. Of those examined, 461 were men, 337 women.

It has, of course, been known for many years that porcelain workers are liable to contract silicosis, though in various degree according to the

[1] Submitted for publication 31. V., 1934.

From the Roentgen Clinic of the State Hospital, Copenhagen (Chief: Ass't professor P. Flemming Møller, M. D.), the Directorate for Inspection of Factories and Workshops (Chief: Erik Dreyer, B. L.) and the State Board of Practical Sanitary Research (Chief: Prof. L. S. Fridericia, M. D.).

particular task at which they are engaged in that industry; but it is also well known that the unfolding of the disease in workers of that category is rather slow, even if it can end by developing into very severe forms. Our investigations confirmed this, and the considerable size of the material with which we had to deal gave us, besides, an unusual opportunity for thorough study of the manner in which the silicosis develops in these workers, as reflected in the roentgenological picture. At the same time, the information obtained, for instance through the sick-benefit societies, in regard to illness among them has added considerably to our knowledge concerning their average health and ability to resist disease in general, and has clearly shown the dangers attaching to a developing silicosis.

To understand the development of the roentgenological picture in silicosis it is necessary to be thoroughly familiar with the manner in which those pathologic processes gradually unfold which take place in the lung, and which, after they have become macroscopic, reflect themselves exactly in the roentgenograms. Before proceeding to describe the roentgenological picture characteristic of the disease in porcelain workers I will therefore briefly trace the sequence of those phenomena and processes which gradually lead to the development of diffuse fibrosis in the lungs of persons working in dust-producing industries.

It was formerly believed that the active agent producing the pulmonary fibrosis was the greater or lesser quantity of silica contained in the dust in those factories where experience has shown that the workers develop silicosis. HEFFERNAN and GREEN (2), especially, believe that they have shown the disease to be the result of a local physio-chemical action of colloidally transformed silica on the lung tissue. According to another theory, recently advanced by the English investigator, JONES (3), the active agent should be, not silica, but a silicate, — sericite. Certain indications speak strongly for this view, though as yet it cannot be said to have been definitely confirmed. On the whole, we must be prepared for the necessity of changing our old conceptions in regard to the origin of silicosis; but on these matters I shall not enter into greater detail here.

When the fine dust particles that have succeeded in passing the ciliated epithelium of the air passages reach the alveoli, they give rise to a catarrhal process which leads to proliferation of certain cells. Some of these become phagocytes, which ingest the dust particles. Many of these »dust cells» are coughed up, but many others pass into the lymphatic system of the lungs. Their wanderings there have been closely studied and followed by many investigators. From the alveoli, many of them are carried with the lymph current to the first lymphoid depots which they encounter on their way. Some are kept back there, others are carried farther along, to the next depots at branching points of the bronchioles, bronchi and vessels, and to the lymph glands of the lungs. Blocking of the lymph flow and lymph

glands and the massing of lymph as the result of the accumulation of »dust cells» at those points produces stasis and favours additional accumulation; and this, together with proliferation of other cellular elements, gives rise to the microscopical phenomenon described by MAVROCORDATO as »pseudotubercles» (see below). It is around these that the characteristic silicotic fibrosis develops. The fibrosis is the essential feature of the pathoanatomical changes in silicosis, and is the condition which determines the characteristic roentgenological changes.

There is still some doubt as to how the inhaled silica — silicates — produce the fibrosis in the lungs. In England and America, where this question has particularly been the object of study, the opinion at present rather inclines toward the view expressed by HEFFERNAN (4), on the basis of experimental investigations by KETTLE and others; according to which the silica and silicates should not, as formerly supposed, act as a protoplasmic toxin on the cells, but should modify them — in a similar manner as tar induces cancer by disturbing their equilibrium — in such a way as to produce changes that result in fibrosis.

The changes begin when the phagocytes containing silica or particles of silicates pass into the lymph spaces of the lung. There, the particles, under influence of the body fluid, are converted into hydrated colloidal silica, which acts upon the protoplasm of the dust cells. This action then spreads to the surrounding cells, which, in their turn, become affected in the same manner; and a fibrous wall is formed around these and a central mass composed of silica sol and the dissolved protoplasm. It is the combined result of these changes which MAVROCORDATO calls the »pseudotubercle».

The colloidal silica gradually becomes dehydrated, and thus loses its effect; but as long as any unconverted pure silica or silicates remain, the silicosis is progressive. If those substances have been inhaled in great quantities, it can therefore continue to spread, even after the person has ceased to work at the occupation producing the dust. Its progressiveness depends on the speed with which the formation of fresh colloidal silica takes place, and this is considerably accelerated by the presence of alkalis. It is for that reason that work with scrubbing powders is so dangerous and gives rise to the swiftest and most violent development of silicosis.

The formation of pseudotubercles is thus the first microscopically demonstrable sign of silicosis, and they represent the microscopic beginning of what later, when the fibrosis has developed to such an extent that it becomes macroscopical, appears as the roentgenologically demonstrable nodulation, — the characteristic, so-called »silicotic nodules», which lie along the course of the lymph vascular system.

Before the changes have reached this point, the slight fibrosis, in connexion with the obstruction of the lymph flow, has however led to the

development of what has been called the first visible stage of the silicosis. Simultaneously with the changes in the lymph depots there are namely other fibrous processes going on, because the gradually increasing blocking of the lymph vessels, and the surrounding reaction, cause further hindrance to the outflow, and further accumulation of dust cells in the channels. Partly as a result of this great accumulation many dust cells are actually pressed into the walls of the vessels, and through them, or wander by themselves through these out into the interstitial lung tissue. The silica or silicates deposited in the latter produces, both in the walls of the lymph vessels and in the interstitial tissue, a fibrous transformation and thickening which gradually becomes apparent in the roentgenograms as a diffuse veiling, at the same time as the tracing of the lung, as a result of the thickened lymph vessels and the fibrosis surrounding them, stands out with greater intensity. It is when the changes have reached this point that we speak of the »first stage of silicosis».

The transition from the first to the second stage is vague. As a rule, however, the second stage is described as showing a greater extension of all these physical changes. The nodular shadows, if such are present, have increased in size and number, and show a tendency to flow together; and also the strong tracing of the lung is further accentuated.

In the third stage it is the diffuse fibrosis that dominates. If the silicotic nodules have been the most outstanding feature in the first stages, these now flow together and form large, irregular masses over both lungs. Besides, there may develop a more or less extensive, diffuse fibrosis, resembling the shadows seen in cases of carnificient pneumonia or tuberculosis; or the changes may show themselves in the form of large, tumor-like masses. At the same time, the pleural changes are strongly pronounced. Such changes always develop in the late stages of silicosis, and belong to the picture of the third stage. They are due to the manner in which the lymph stream, when its normal passage towards the hilum is blocked, seeks another way out towards and through the subpleural paths. This gives rise to the same processes there as in the lung, and results in the development of a fibrously altered pleura with numerous strong adhesions.

As the different forms of silicosis resulting from occupation in the various dust-producing trades have become the object of closer study it has been found that as regards certain of these occupations it is very difficult to maintain the former division of the changes into three stages as the only one. In the silicosis affecting asbestos workers, granite-cutters, makers of cleaning powder, and others, for instance, it has often been impossible to identify a second stage; the first stage passes directly over into the third, and at the same time the appearance of the roentgenographic picture can vary so much, according to the different manner and

the greater or lesser rapidity with which the silicosis develops in the different trades, that it can be impossible to make the picture fit into the scheme of division hitherto employed. The first international conference on silicosis, held in Johannesburg in 1930, realised this, and recommended that after further studies an attempt should be made to have an internationally serviceable terminology adopted, which would be a better expression for the various types of the disease than those hitherto employed.

PANCOAST and PENDERGRASS (5), proceeding from the argument that the clinical phenomena must necessarily depend on certain definite pathoanatomical changes, and that the roentgenological picture must reflect these exactly, have tried to substitute for this old numerical division of the silicosis, which is typical for only a relatively small number of occupations, a general, at the same time pathoanatomical and roentgenological classification, embracing both the typical pictures and the variants, and applicable both to clinical and roentgenological studies of any industry and occupation. As this classification of the various forms of silicosis seems to me the best one proposed so far, I shall give a very brief outline of it.

Owing to the manner in which the lymphatic vascular system is distributed through the lung, and as it is apparent especially from MILLER's (6) investigations concerning it, there are practically only three ways in which the dust can primarily be distributed in the lung, or three points where it can primarily accumulate in the latter, — which correspond to possible later manifestations of the fibrosis; namely, 1) the peribronchial and perivascular lymph vessels, whose blocking causes densification and increased intensity of the lung tracing and the pulmonary lymph nodes; 2) accumulation especially in the lymphoid depots and lymph glands, with subsequent development of nodular fibrosis; 3) a mainly interstitial fibrosis, resulting from the rapid obstruction of the lymph channels, with partial bursting or egression of the dust particles from the latter. To all this may then be added the pleural changes, which are more or less common for all cases.

From the study of the various dust-producing industries it is evident that one of these three manners of distribution of the fibrosis is predominant in each of them. Thus, according to PANCOAST and PENDERGRASS, the nodular type prevails among drillers in the coal mines, while the workers who only break the stones in the mines get the peribronchial type, and get it very slowly. Granite-cutters get an interstitial type without nodular changes; workers in scrubbing-powder factories very soon develop diffuse fibrosis. The two authors have set up the following five types as their pathologic-roentgenologic classification of silicosis:

1) Peribronchial-perivascular type with slight lymphonodular changes { slowly progressing. / rapidly » .

2) Early interstitial type { with nodular changes. / without » » . / slow or rapid.

3) Late or advanced interstitial type.

4) Nodular type { progressive. / not » .

5) Advanced diffuse or terminal fibrosis { conglomerating. / nodular type. / interstitial type. / massive, fibrotic type.

Obviously, as the authors say, the changes are in many individuals or occupations characterised by some variation or other of these types; but in each industry, and the special occupations within it, there will usually be one type that predominates, and with which the clinical picture presented by the disease, and its manner of progress, will agree exactly.

As regards the various forms of silicosis that I have had occasion to observe, and which represent most of the occupations that produce silicosis in Denmark, I have tried to place the varying pictures according to this classification, and it seems to me that if one's interpretation of them is done with due attention to all the details, it enables one to characterise the various forms, and the different pictures which the disease produces, in a very clear and easily intelligible manner.

If, in caracterising the *silicosis in porcelain workers*, of which I am going to speak in the following, I have used also the division into a first, second and third stage, it is because, for a statistical treatment of the different grades of development, such as has been undertaken by Dr. GUDJONSSON in dealing with the same category of workers, it has been most practical to maintain such a gradation within the type, in order to get an impression both of the incidence, on the whole, of silicosis among them, and of the degree of its development and the varying rapidity with which that development takes place according to the different tasks on which the workers are engaged in that industry. The type of the changes is very regularly the same, though, in all the workers; and places them as belonging to Group I of PANCOAST and PENDERGRASS' classification, — the peribronchial-perivascular, nodular type, with tendency to rather early interstitial changes.

When one has to pass judgment in rapid succession on the roentgenograms of so many persons as it was the case in the examination of

this rather considerable number of porcelain workers, it is impossible, in classing the cases, to confine oneself to a very few groups. It is obvious that the classification must be to some extent a matter of cursory estimate, and this has also found expression in the designations used for the 8 groups in Table I.

Table I. Distribution of the silicosis

Diagnosis	Women	Men	W + M
1. No silicosis	194	95	289
2. Hardly, or no positive s.	52	96	148
3. Perhaps incipient s.	27	72	99
4. Slight, or very slight, s.	11	38	49
5. Incipient, or perhaps slight 2nd stage, s.	43	75	118
6. 2nd stage s.	5	39	44
7. Severe, or pronounced second stage, s. .	5	28	33
8. 3rd stage s.	0	18	18
Total	337	461	798

It is altogether very difficult, and requires great experience, to judge whether incipient silicosis is present in a given case. In classing the pictures I have therefore endeavoured to be as sober in my estimate as possible. And in order to be sure that the dividing lines between »silicosis» and »no silicosis», and between groups 2 and 3 of Table I, were correctly drawn, I have later gone over the whole material again, and was able to ascertain, with the greater experience I had by that time gained, that all the cases which I at first scrutiny had classed as »perhaps incipient silicosis» were undoubtedly positive. The percentage of silicosis found among all the workers — 45,2 per cent. — is thus not too high. Rather may it be said to be a little too low, inasmuch as the later review showed that several of the cases that had originally been marked »hardly, or no positive, silicosis» must, after all, be said to have silicosis.

In order to have a basis for comparison with the first demonstrable roentgenological changes in the lung in porcelain silicosis, I reproduce in Fig. 1 the normal lung of a young woman, twenty-four years old. The first that strikes one in comparing this picture with Fig. II, which shows the earliest demonstrable silicotic changes in the lung of a man, twenty-seven years old, who had been turner in a porcelain factory for ten years, is a distinct, veiled transparency of the organ in the latter. The fine, sharply drawn, reticular design seen in the picture of the normal lung has here become very much denser, the separate lines of the design are woolly and without sharpness; it is as if there lay a veil over the lungs.

This is a picture which repeats itself in all the porcelain workers also in the first stage of the silicosis. It develops more and more as the disease progresses, and is a very clear illustration to the peribronchial-

perivascular type of silicotic development, with the tendency to early interstitial changes.

If we follow the further development of the changes, we see how these become more and more pronounced in the picture of the lung. In *Fig. III* (three years' work at clay-washing), which is a slightly more advanced case, it will be noticed that, especially towards the periphery, it becomes very difficult to distinguish the separate elements of the lung design clearly from each other; they almost flow together into one diffuse veil. Besides, we find in this picture a very characteristic phenomenon, which is exceedingly frequent in the first stage, not only of porcelain silicosis, but also in the silicosis affecting workers in several other industries; namely, a particularly strong veiling of a circumscribed area almost in the centre of both lungs, perhaps a little more pronounced in one than in the other. These denser areas remind very much of the shadows which the small mammae of a young woman, or the strongly developed pectoral muscles of a man, produce in the roentgenogram; but they are situated somewhat higher than is the case, as a rule, with the shadows of the mammae. For that reason, and because the phenomenon occurs so frequently, I have called these shadows »pseudo-mammae».

PENCOAST and PENDERGRASS have been the first to describe these changes, and they rightly speak of their presence as a valuable indication of incipient silicosis. The shadows must be taken as expression for a rather early development of interstitial fibrosis at those points, due to particular accumulation of the dust there.

The characteristic feature of the 1st stage of porcelain silicosis is thus the density and diffusedness of the reticular design in the lung picture, and the diminished transparency of the lungs. On the other hand, there is no development of large patches of silicotic nodules. There may of course be patches, in addition to the other changes, but as I have repeatedly said, it is the peribronchial-perivascular type that predominates.

This also becomes apparent when we look at the transitional forms that lead to the stages of more intense development.

The particular enlargement or effacement of the hilum shadows which is always described as accompanying silicosis, is not seen in porcelain workers until we reach the terminal stages. This is perhaps because the process in these workers progresses slowly; but on the whole it is my experience that this increase in the breadth of the hilum shadow, as well as the presence of enlarged glands in that locality, can altogether very rarely be demonstrated also in other forms of silicosis.

Fig. IV, from a woman, fifty-two years old, who had been engaged in »blue-decoration» for thirty-six years, shows a typical case of 2nd stage silicosis. The picture gives one the clear impression that a very large

Fig. 1. Normal Lung.

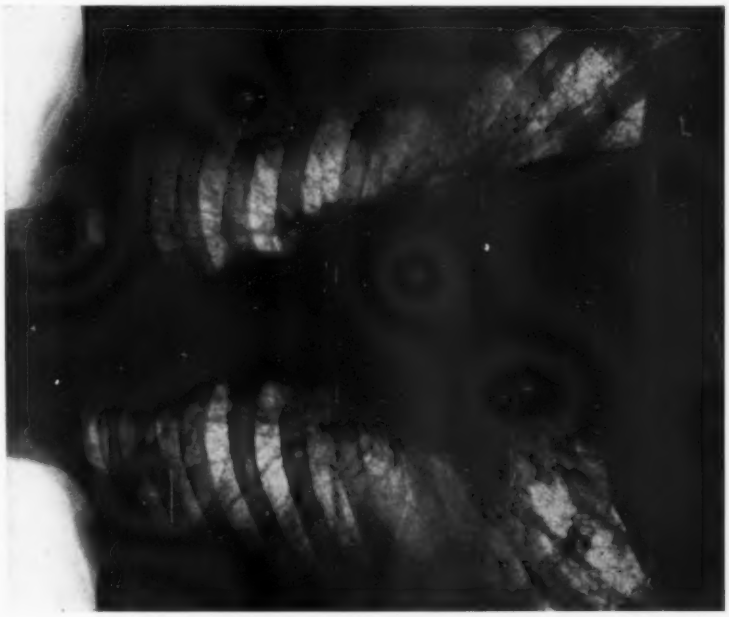


Fig. 3.

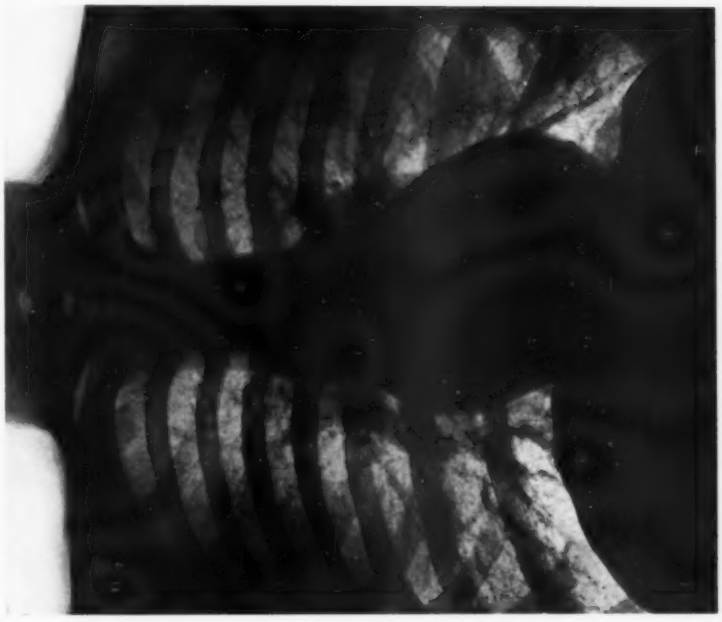
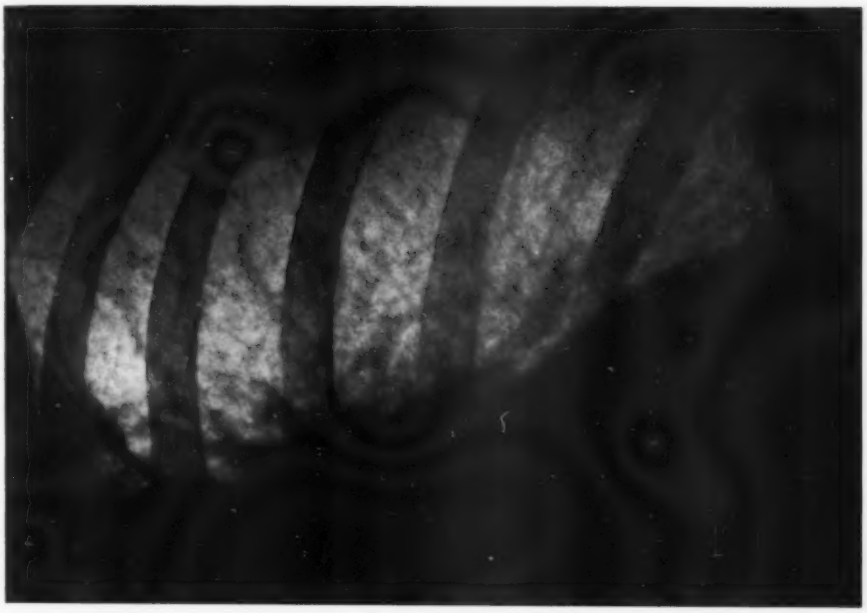


Fig. 2.



Detail of Fig. 4.

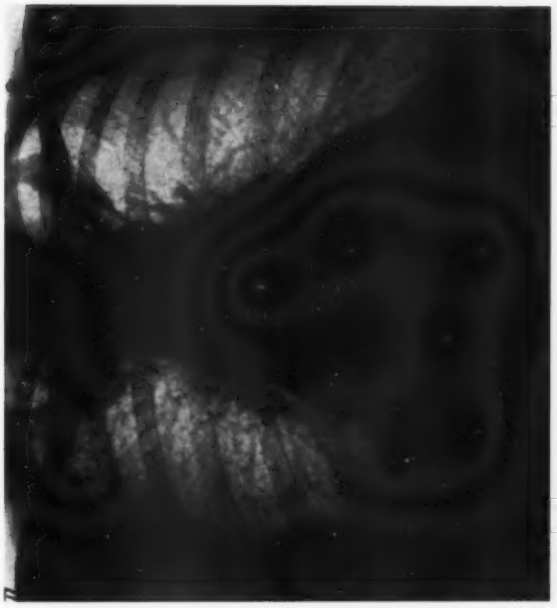


Fig. 4.

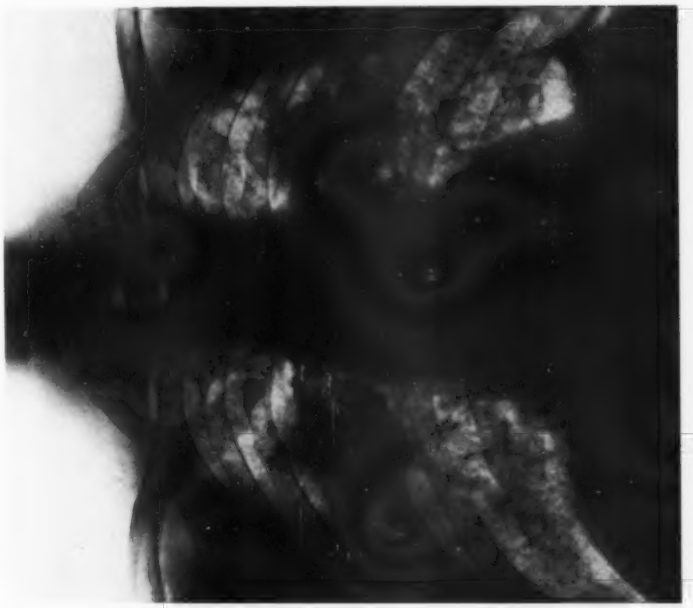


Fig. 6.

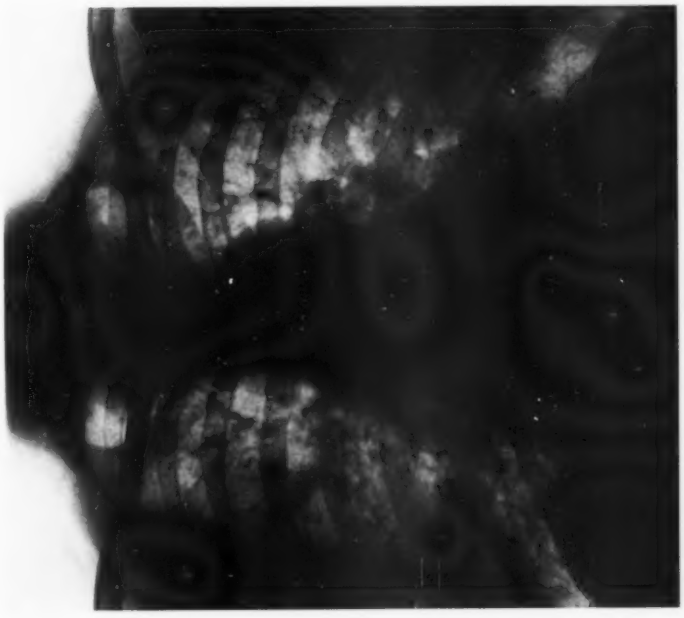


Fig. 5.

Fig. 7. Post mortem.

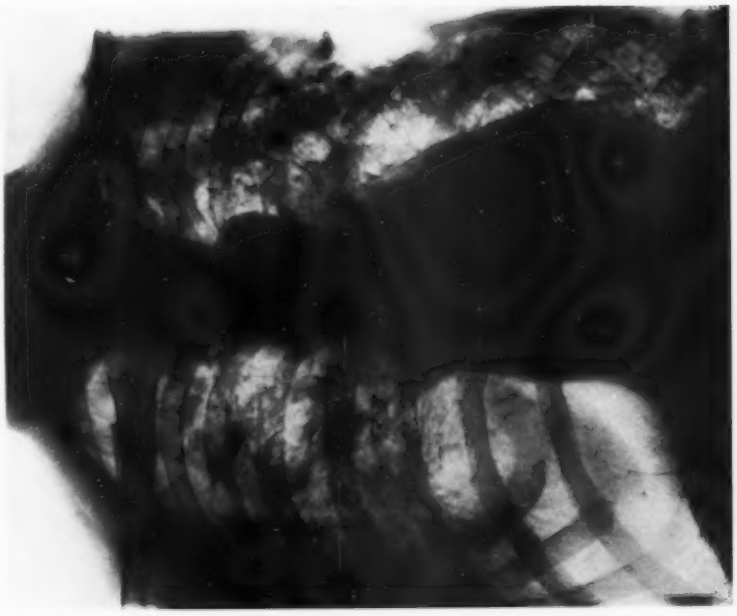


Fig. 7.

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part of the lung's air capacity has been lost; the veiling being almost completely diffuse in the lower portion, towards the base.

Fig. V, from a man, fifty-three years old, who had been a former for forty years, shows the 3rd stage in its full development: the almost tumor-like opacities, symmetrical in both lungs, and the pronounced pleural changes and strong adhesions both to the thoracic wall and to the diaphragm, which are so characteristic for the severe forms of silicosis. Also the shrinking which always accompanies the fibrosis is clearly evident in this case, and finds expression, among other things, in the emphysema in the lower part of the left side. Also the bullous rarefactions that are seen especially on the left side, in the periphery of the nodulous formation out towards the thoracic wall and behind the diaphragm, are perhaps due to the same cause, and possibly indicate a development of emphysematous vesicles in that part of the periphery, as a result of the shrinking. I shall come back, in the following, to this question, which has a very important bearing on the subsequent fate of these individuals.

Fig. VI, from a man, forty-seven years old, who had worked for twenty-eight years at the ovens and at brick-making, shows a somewhat different form of the terminal stage, with the large, cake-shaped, diffuse fibrosis of the left side. Also in this case the shrinking and the strong adhesions are markedly pronounced, as well as the vicarious emphysema in the relatively free portions of the lung.

The pictures here described give a very clear idea of the development of the porcelain silicosis, and illustrate well the transition of the type to the diffuse fibrosis of the terminal stages.

In going over the roentgenograms of the large material, I have been struck by the fewness of complications to the silicosis that I have found. The one which in practically all works on the disease is spoken of as the most frequent and most serious is *tuberculosis*. The present material has confirmed what previous experience with regard to porcelain silicosis had already shown me; namely, that tuberculosis is relatively rare among the workers in that industry, and that very few of them had tuberculosis in any severe degree. It seems as if the fibrosis in these individuals acts as a barrier to any strong development of the tuberculosis; something that may also be noticed in other forms of silicosis in other industries where the development of that disease is only slowly progressive. Of 361 workers — men and women — with silicosis, only 43 had demonstrable glandular tuberculosis of the hilum, in the form of calcifications; while only 6 had fresh tuberculosis. Of the 467 without silicosis, 65 had glandular, 3 fresh tuberculosis.

When one is confronted with the large nodulous opacities in the roentgenograms of the terminal stages of silicosis, it *can* be extremely difficult to determine whether there is complication with tuberculosis,

unless there are also unmistakable calcifications. Several authors maintain, however, that these large nodulous opacities are always to some extent due to complication with tuberculosis. This is undoubtedly not correct. At all events as regards porcelain silicosis, the 3rd stage cases in the present material, except where there were calcifications or other positive signs of tuberculosis, may be said to be pure terminal silicotic fibroses, also roentgenologically.

A complication very rarely mentioned in the literature on silicosis is *spontaneous pneumothorax*. This was found in two cases of the present material. One of them was that of a man, sixty-two years old (Fig. VII), who had been a porcelain turner for forty-seven years, and who had silicosis in the 3rd stage. He declared himself that he was in good health, but had a large pneumothorax of the right side, filling the lower half of the thorax. I shall come back to this case, the subject of which subsequently died suddenly from a fresh, spontaneous pneumothorax. The other case was that of a man, forty-one years old, who had worked for eight years in the clay cellars. He had mild silicosis in the 2nd stage, complained of »asthma», and had a small pneumothorax over the upper part of the right lung.

I shall speak a little more of this complication in the following, as I believe that it has a great deal more to do with the shrinking, slowly progressing silicoses than has hitherto been supposed, and that, as a matter of fact, it means a continuous risk of sudden death for these individuals.

A complication frequently found — and which one would also expect to find in such cases, where the functioning of a great part of the vital lung tissues has become suspended — is *emphysema*, which is always very apparent in those parts of the lung where the fibrosis is not particularly strongly developed, and which also expresses itself in a barrel-shaped, emphysematous deformity of the thorax.

Also *hypertrophy of the heart* is rather frequently observed, especially in the later stages of the silicosis; and as a matter of fact it is not very surprising that the heart should become hypertrophied, considering the abnormal conditions of blood circulation resulting from the fibrotic state of the lungs. We therefore also see heart disease stated as the cause of death in not a few cases.

When one considers so large a material as the present one, in which over 45.2 per cent. of those examined had silicosis, and in which 213 of the 361 cases of that disease must be characterised as 2nd stage, or even severer, one cannot help wondering that all these people, who, at the time they were examined, were able to work at their various occupations, on the question blanks which they were asked to fill out, in spite of the severe changes described themselves as in good health. Of course, there were a

number of complains; but most of those that could be considered as having any relation to the disease discovered were of shortness of breath, and of a tendency to colds and cough. The complaints of dyspnea came especially from those in whom the silicosis had reached a strong degree of development, but also from some with silicosis only of the 1st degree; yet it was only in a very few cases of 3rd stage silicosis that the shortness of breath had prevented them from working.

The circumstances of course precluded any detailed questioning or examination of separate individuals; so it is quite possible — or perhaps even probable — that a closer investigation of individual cases might have shown that some of them really found it difficult to keep up the pace in their work; but as to that it is thus impossible to say anything positive.

In the part of the material that he has dealt with statistically, Dr. GUDJONSSON has shown that the individuals affected with silicosis have a tendency to diseases of the respiratory tract. It is only slightly greater than in those who do not have silicosis, but it exists; and among the causes of death about one half, in fact, are affections of the air passages. Of the 46 deaths in regard to which there is any information, 21 were due to such affections, 3 to heart disease, 22 to other causes.

That silicosis under certain conditions must place the individual in a »state of inferiory» is something, however, that it does not need any statistics to make evident; and the points at which the lesser power of resistance, or a previous disposition, may possibly have played a part, or where simply the silicosis direct can be said to be the cause of a complication, must in the first instance be the organs of the chest. It is, of course, also evident that an affection of the air passages, whatever its nature, must entail a very serious risk for an individual of the vital part of whose lung a great — or perhaps the greater — part has been put out of function; and this risk must be said to begin rather early, and increases as the years go on. It is true that in the porcelain workers the silicosis develops relatively slowly; still, it begins already after three years' work. It is steadily progressive, yet they do not get silicosis of the 2nd stage until after ten years; of those who have worked at the occupation for from twenty-six to thirty years 58 will have silicosis, of those who work for fifty years 100 per cent.

Apart from the risk attaching to the ordinary affections of the air passages, where also the emphysema undoubtedly plays a part, it is especially the *spontaneous pneumothorax* and *degeneration of the heart* that are likely to compromit the life of these workers, and must be said to constitute a permanent menace to them. The former is, as I have already said, mentioned very little in the literature on silicosis, but the experience we have gathered in our study of the porcelain silicosis, and

especially a case of death where the post mortem showed bilateral spontaneous pneumothorax has convinced me that this complication is probably a much more frequent cause of death than hitherto supposed.

There is also lacking a sufficiently large post-mortem material with regard to deceased silicotic workers to enable us to determine the actual causes of their death; and in the present material it is either not precisely stated or very uncertain.

As regards the man just referred to, he had, at the time when he was examined together with the other workers, a large pneumothorax of the right side, and, besides, silicosis in the 3rd stage, and between the silicotic opacities in the lung numerous rather clearly circumscribed rarefactions of varying size, which were interpreted as emphysematous lung tissue between the fibrous changes. At the time of the examination he declared that his health was good and that he was able to attend to his work, though perhaps he might be somewhat short-winded. The examination took place on July 20th, 1932. He remained at his occupation until December of the same year, when he one day suddenly collapsed at his work, was brought by ambulance to the Frederiksberg Hospital, and died there a few hours after. On *autopsy* (7) pneumothorax of the left side was found, and the lungs, on being removed, showed the characteristic, enormous changes seen in Fig. VIII. There was also myofibrosis of the heart. Beside the characteristic silicotic changes it was found, as the illustration clearly shows, that the portions of the lungs that were relatively free from fibrosis were transformed into an enormous, emphysematous lung tissue, with one large emphysema vesicle close to the other, one of them even as large as an orange. It was the bursting of one of these vesicles that had caused the pneumothorax. Besides, there were numerous adhesions, both to the thoracic wall and to the diaphragm. Except for a few calcified nodules, there were no signs of tuberculosis.

A comparison of the autopsy preparation of these lungs with the roentgenological picture of the other developed stages of silicosis, whether so-called 2nd or 3rd stage, must cause us to modify our view of the latter somewhat. As I have already said, the pictures clearly show that emphysema is exceedingly frequent, and also that this emphysema may be located at various points between the fibrous striae and changes; but it is very rarely possible from the picture to tell that emphysema vesicles are present, as the autopsy showed in this case. Yet the latter proves that they must have been there in the case in question, and that they are probably present, more or less pronounced, at least in all cases of a fully developed silicosis with distinct fibrous striae and opacities of any size distributed all over the lung.

That they can be present also in less pronounced cases, and even at a stage that one would describe as midway between the 1st and 2nd, is

proved, however, by the other instance of pneumothorax which the present material contains. In the roentgenogram of this it was not possible to detect anything that might with certainty be designated as probable emphysema vesicles, but there was pronounced emphysema. This case shows that the danger of spontaneous pneumothorax occurring may exist at a rather early stage of the development of silicosis, and must therefore be said to constitute a dangerous risk for these workers, the functional capacity of whose lung tissue is already compromitted.

The literature contains descriptions of the occasional finding of caverns in connexion with silicosis. After my own experiences I very much doubt the correctness of the statements to that effect. What has been observed has probably been emphysema vesicles, and it is quite possible that a number of cases that were formerly taken to be tuberculosis in conjunction with silicosis, because the observers believed that they saw caverns in the roentgenogram, did not have that complication to the silicosis, but that the rarefactions observed represented emphysema vesicles in a pure 3rd stage silicosis.

I do not mean to say that emphysema and emphysema vesicles are to be found in every form of silicosis. Where the development of that disease is very rapid, and there very soon comes diffuse interstitial fibrosis, I do not believe that there are any chances for the development either of very marked emphysema or of emphysema vesicles. But where the progress of the silicosis is relatively slow, as in porcelain workers, so that there will be time for the development of shrinking in those portions of the lung where the silicosis and fibrosis have particularly located, it is also highly probable that localised emphysematous areas will develop between the fibrously altered portions, and that thus also emphysema vesicles will form, which may burst at any moment and give rise to a spontaneous pneumothorax that will endanger the life of the subject thus afflicted.

The other danger that menaces the workers is *degeneration of the heart*. It is evident that the development of silicosis must entail increased work for that organ, and the rate of that increase becomes greater as the silicosis progresses. Nor can there be any doubt that this in the course of years will have an effect on the heart muscle; and if we look through the roentgenograms we cannot fail to be struck with the frequency with which we, in the later stages, find expressions of this in an enlarged heart shadow. Also instances of hypertrophied heart in connexion with silicosis are described by many authors. It is true that there are no existing records of any post-mortem examinations on deceased silicosis patients with special view to the study of that question, but another case of death of a porcelain worker that we had occasion to deal with had features that pointed very much to a »heart stroke» as the lethal cause. The deceased

was a relatively young man, who had not been working in the industry for more than five years, but who at the examination in 1932 showed »possibly incipient silicosis». He was in perfectly good health, had never been ill, and, especially, had never had any particular infectious disease. Two years after the examination had taken place he suddenly one day collapsed at his work, and died instantly. The autopsy showed emphysema along the lower margin of his lungs and of the anterior one-third of these. There were a few adhesions to the apices; the density was increased; there were no signs of tuberculosis. The posterior surfaces of the pleura were somewhat thickened. The heart measured 11 × 10 centimeters, and weighed 360 grams. Macroscopically, the myocardium presented nothing abnormal. *The coronary arteries showed slight atheromatous changes.* The rest of the examination showed nothing abnormal. Medico-legal conclusion: slight chronic changes in the lungs; signs of congestion of blood to the spleen, liver and kidneys. *Microscopy:* lungs, 1st degree diffuse, circumscribed fibrosis (positive silicosis); acute and chronic lung stasis; chronic fibrous adhesive pleuritis. *Heart: myofibrosis of the first degree.* Lymph glands: hyperemia of the bronchial glands; reticulo-endothelial hyperplasia; anthracosis.

Beyond silicosis of the lungs, the autopsy thus showed nothing abnormal in the organs except a slight degeneration of the heart muscle and atheromatous changes in the coronary arteries. A positive connexion between those changes and the relatively slight silicosis cannot be proved, of course; but no other causes could be demonstrated. From the manner in which the death occurred it must however be supposed that it was due to weakening of the heart, and the case should warn us to be watchful also with respect to this point. In the study of silicosis we lack sufficiently exact information in regard to results of autopsies, with the necessary microscopies; and in Denmark, at least, the actual causes of death are not sufficiently elucidated.

The present material thus shows that silicosis — as might be expected, and as also previous investigations had indicated — is very prevalent among porcelain workers. It proves to be a relatively slowly but steadily progressing process of the relatively benign peribronchial-perivascular-nodular type, with tendency to interstitial changes. It leads , however, to 100 per cent. of the workers having silicosis in a severe degree after fifty years.

Though it might appear as if the silicosis, in spite of the severe degree to which it develops in the individual cases, does not affect the workers to any great extent, inasmuch as, with a few exceptions, they were all in possession of their capacity for work at the time when the examination took place, the investigation nevertheless showed that the disposition to sickness was rather great among those who were affected with silicosis;

that the tendency to affections of the air passages is greater in the latter than in those who did not have silicosis; and that in one-half of the cases diseases of the respiratory tract was the cause of death. To this it must be added that not a few of the workers complained of dyspnea, coughs, and a tendency to colds.

Besides, the risk entailed by the ordinary affections of the air passages, the investigation has however disclosed that two other risks are liable at any time to compromit the life of those who have contracted silicosis, namely spontaneous pneumothorax and degeneration of the heart; and that not only in the late stages of the disease, but also at a relatively early stage. Complication with tuberculosis was found to be relatively rare, and severe cases of the latter disease were not observed. Emphysema is exceedingly frequent among the sufferers from silicosis.

The silicosis is thus by no means an innocuous affection. It is a disease that marks its man, and against which the most thorough prophylactic measures possible should be taken. The present investigation has given a great deal of valuable information as to its nature and the manner of its development, but on many points reliable information is still lacking, which would enable us fully to clear up the problems of many kinds that the study of silicosis involves, and which the present investigations have not enabled us to solve.

SUMMARY

An examination of 859 porcelain workers, 798 of whom were roentgenographed, showed that an indifferent state of health was rather prevalent among those affected with silicosis, and the tendency to diseases of the air passages greater in them than in the workers not thus affected. Besides diseases of the latter kind, two other risks are liable at any time to compromit the life of those who have contracted silicosis; namely spontaneous pneumothorax and degeneration of the heart. Emphysema is exceedingly frequent; tuberculosis comparatively rare. The silicosis is slowly progressive, of the peribronchial-perivascular-nodular type (PANCOAST and PENDERGRASS), with tendency to early interstitial changes. It leads to 100 per cent. of the workers having silicosis in a severe degree after fifty years.

ZUSAMMENFASSUNG

Eine Untersuchung an 859 Porzellanarbeitern, von welchen 798 röntgenphotographiert worden waren, zeigte, dass unter diesen mit Silikose affizierten Fällen mehrenteils ein ungünstiger Gesundheitszustand vorherrschte, und dass die Neigung zu Erkrankungen der Luftwege bei ihnen grösser war als bei den Arbeitern ohne diese Affektion. Ausser von Krankheiten der letzteren Art, kann das Leben der an Silikose leidenden jederzeit von zwei anderen Gefahren bedroht werden, nämlich von spontanem Pneumothorax und von Herzdegeneration; Emphysem kommt ausserordentlich häufig vor, Tuberkulose verhältnismässig selten. Die Silikose ist langsam progressiv und vom peripronchial-

perivaskulär-nodulärem Typus (PANCOAST and PENDERGRASS) mit Neigung zu frühen interstitiellen Veränderungen. Dies führt dazu, dass 100 % der Arbeiter nach 50 Jahren eine Silikose schweren Grades haben.

RÉSUMÉ

L'examen de 859 ouvriers porcelainiers, dont 798 furent radiographiés a montré qu'un état précaire de santé prédominait plutôt chez ceux qui étaient atteints de silicose; la tendance aux affections des voies aériennes était plus marquée chez ceux-ci que chez ceux qui ne présentaient pas de silicose. En dehors de ces derniéres maladies, les ouvriers atteints de silicose peuvent être menacés de deux autres affections, notamment la pneumothorax spontané et le dégénérescence cardiaque. L'emphysème est extrêmement fréquent, la tuberculose relativement rare. La silicose du type péribronchio-périvasculo-nodulaire est lentement progressive (PANCOAST and PENDERGRASS), avec tendances aux lésions interstitielles précoces. Elle aboutit dans une proportion de 100 % des ouvriers atteints de silicose, à un degré grave après cinquante ans.

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AUS DEM PHYSIKALISCHEN LABORATORIUM DES RADIUMHEMMET IN STOCKHOLM.
VORSTAND: R. M. SIEVERT

ÜBER DIE EINWIRKUNG DER RÖNTGENBESTRAHLUNG AUF DIE ENTWICKLUNG VON MESOTAENIUM CALDARIORUM[1]

von

Arne Forssberg

Nach einer Röntgenbestrahlung entstehen chemische und physikalische Veränderungen in der Zelle, die (vorausgesetzt dass die Dosis gross genug war) ganz charakteristische zytologische Abnormitäten zur Folge haben. Insbesondere ist die Einwirkung auf den karyokinetischen Verlauf schon mehrmals beschrieben worden. (Siehe z. B. ALBERTI und POLITZER (1), WHITMAN (2), HENSHAW (3), KEMP (4), COX (5) u. a.) Zusammenfassend lässt sich der Verlauf in folgender Weise darstellen.

Kleine Dosen[2] geben keine morphologisch wahrnehmbare Veränderungen im Zellengebilde. Bei Zunahme der Dosis treten Verzögerungen im Beginn der Zellenteilung ein, (JÜNGLING und LANGENDORFF (6)) wie auch gleichzeitig die Kernteilung in abnormer Weise verläuft, was alles bei noch grösseren Dosen noch ausgesprochener aufzutreten pflegt. Anhäufung von Chromatin, Fragmentation von Chromosomen (KEMP (4)) sowie multipolare Mitosen und mehrkernige Riesenzellen (ENGELMANN (7), PATTEN und [illegible]GODER (8) u. a.) sind hier gewöhnliche Erscheinungen, die schliesslich zum Stillstand der Entwicklung und zum Tode der Zelle führen.

Die Frage, ob durch einmalige, sehr grosse Dosen das Zellenleben *sofort* zum Stillstand gebracht werden kann, ist von SCHECHTMANN (9) an Rana esculenta-Eiern behandelt worden. Er fand jedoch bei Bestrahlung mit 72 000 r (tötliche Dosis 400 r), dass die erste Furchung noch rechtzeitig stattfand. Im Gegensatz zu ihm fanden H. und M. LANGENDORFF (10) an Axolotl-Eiern, dass eine Dosis von 300 000 r die Entwicklung sofort zum Stillstand brachte.

[1] Bei der Redaktion am 15. VIII. 1934 eingegangen.

[2] Natürlich ein relativer Begriff, der je nach dem Objekt wechselt.

In vorliegender Arbeit wird über einige Bestrahlungsversuche mit der einzelligen Alge Mesotaenium caldariorum, insbesondere über den quantitativen Zusammenhang zwischen Zellengrösse, Zellenteilung und Röntgendosis, berichtet.

Bezüglich der Kultur und Vorbehandlung der Algen wird auf die Arbeit von PRINGSHEIM (11) und eine frühere Abhandlung (12) in dieser Zeitschrift hingewiesen. Die normale Entwicklung der Alge ist in grossen Zügen folgende: Die Algen sind als Junge stabförmig und etwa 25 μ lang und nehmen nach der S-förmigen Kurve in Fig. 1 n im Volumen zu. Nachdem die Algen etwa am vierten Tage eine maximale Länge von rund 40 μ erreicht haben, fängt der Teilungsprozess an. Diese Teilung ist eine normale vegetative, deren Einzelheiten wegen der kleinen Dimensionen der Kerne jedoch schwer zu beobachten ist. Es entstehen zwei Kerne; alsdann erfolgt die Wandbildung, und die zwei Tochterzellen trennen sich von einander. Der Entwicklungszyclus fängt dann wieder von Neuem an.

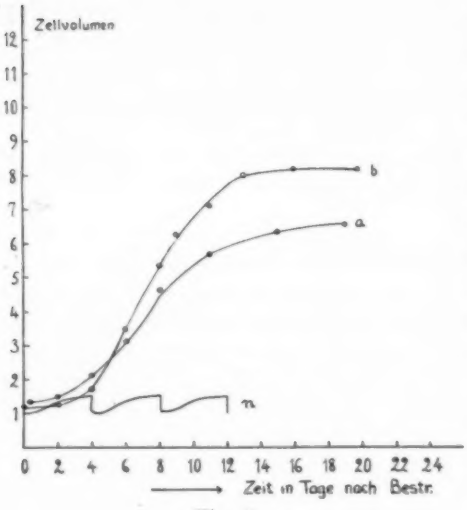

Fig. 1.

Die Bestrahlung wurde mit einem Stabilivoltapparat und einem Müller Metwa Metallixrohr vorgenommen. Filter 0.07 mm Cu + 1 mm Al. Spannung 170 kV. Die Intensität 1280 r/Min. wurde von Zeit zu Zeit mit dem Mekapion bestimmt, welches Instrument mit der hiesigen Standard-Fasskammer (THORAEUS (13)) geeicht worden war.

Die Grösse der Algen wurde im Okulargitternetz gemessen und wird im Folgenden in relativen Einheiten wiedergegeben. Unmittelbar vor der Bestrahlung wurde im Felde des Mikroskopes eine grössere Anzahl Individuen in verschiedenen Entwicklungsstadien markiert und ausgemessen. Nach der Bestrahlung wurden dieselben Individuen im Mikroskope in ihrer Entwicklung jeden Tag beobachtet und wiederholt gemessen.

Die Ergebnisse lassen sich in folgender Weise zusammenstellen.

Gibt man niedrige Dosen (bis zu etwa 2000 r) sind keine Abweichungen von dem normalen Aussehen festzustellen. Die Zellen beendigen in rechter Zeit und ganz normal ihre Teilung. Bei Dosen über 2 000 r

zeigt sich allmählich eine Verzögerung des Zellenteilungsintervalls in der Weise, dass Zellen, die normal zur Teilung gelangen sollten, diese um eine oder mehrere Tage verschieben. Gleichzeitig kommt auch ab und zu Kernteilung vor, die aber nicht von Wandbildung begleitet ist. Das Protoplasma und somit auch das Zellenvolumen zeigen jedoch die gewöhnliche Zunahme, und es entstehen also mehrkernige Riesenzellen. Diese Grössen-Zunahme der Zellen ohne Wandbildung zwischen den Kernen und folglich auch ohne Bildung von neuen Individuen steigt mit der Zu-

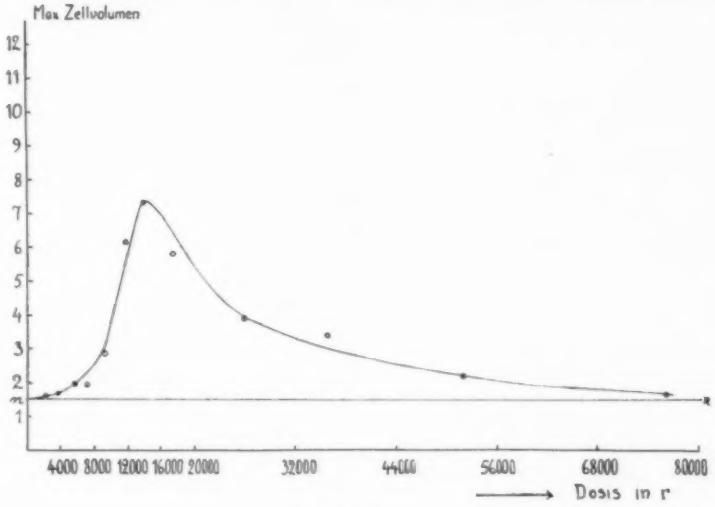

Fig. 2.

nahme der Dosis rasch zu einem maximalen Durchschnittsbetrag von etwa dem Fünffachen des normalen Volumens, welches bei etwa 15000 r erreicht wird (siehe Fig. 2). Die Zellen sind nun durchschnittlich sechskernig.

Bei noch grösseren Dosen (bei meinen Versuchen habe ich bis jetzt max. 76 000 r gegeben) sinkt aber die erwähnte maximale Grössenzunahme der Zellen und geht bei sehr grossen Dosen wahrscheinlich assymptotisch bis auf den normalen Durchschnittswert herab. In der graphischen Darstellung ist jeder Punkt das Mittel mehrerer (etwa 100) Einzelmessungen. Die Abcsisse gibt die Dosis in r an. Als Ordinate ist das Zellenvolumen in relativen Einheiten genommen. Die normale, maximale Zellengrösse liegt bei dem relativen Volumenwert 1.50.

Die Volumenzunahme der einzelnen Zellen nach der Bestrahlung gestaltet sich nun bei solchen Individuen, bei denen die Dosen dem steigenden Kurvenast des Diagramms entsprechen, prinzipiell verschieden

von denjenigen, die dem fallenden Kurvenast angehören. Je grösser die Dosis, desto steiler verläuft die Zuwachskurve. Es wird dies graphisch in den Figuren 1 a und b und Fig. 3 veranschaulicht.

Die Kurven a und b der Fig. 1 zeigen zwei charakteristische Fälle. Gegeben wurden 10 000 bzw. 14 000 r. Man sieht, wie die Zuwachskurve eine der bei normalen, unbestrahlten Zellen vorkommenden zwar ähnliche aber sehr stark vergrösserte Form annimmt. Ehe die Zellen den Scheitelwert erreichen, haben die Kerne sich in den meisten Fällen mehrmals geteilt; die Zellen sind in diesem Stadium meistens vier- bis achtkernig; durchschnittlich sechskernig. Anscheinend ist nur die Fähigkeit zur Wandbildung beeinträchtigt worden, während die übrigen Zellenfunktionen noch normal zu verlaufen scheinen. Die achtkernige Riesenzelle ist etwa achtmal so gross wie die normale Zelle und die Zeit, die sie zu ihrer Bildung braucht, liegt in der Nähe von der Zeit die bei normalen Verhältnissen zur Bildung von acht Tochterzellen nötig ist. Nach Erreichung dieser maximalen Grösse hört die Kernteilung auf, und die Zelle geht von nun ab allmählich zu Grunde. Bisweilen kommt es aber vor, dass diese mehrkernigen Zellen schliesslich doch noch zur Wandbildung gelangen, wobei die Tochterzellen später meistens normal erscheinen.

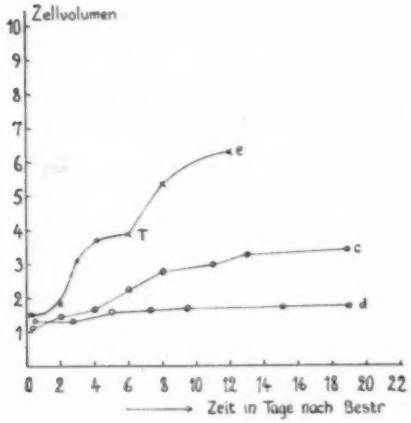

Fig. 3.

Die Verhältnisse bei noch grösseren Dosen (fallender Kurvenast der Fig. 2) werden durch die Kurven c und d der Fig. 3 veranschaulicht. Hier scheint auch der normale Rhythmus des Zuwachses der Zelle gestört zu sein. Man bekommt nicht die gewöhnliche Zuwachskurve, sondern unregelmässige, mehr geradlinige Kurven. Auch bilden sich bei diesen grossen Dosen in den Zellen durchschnittlich nicht so viele Kerne, sondern die Anzahl derselben nimmt mit der maximalen Volumenzunahme ab.

Die Kurve e zeigt schliesslich eine Eigenschaft, die in manchen Fällen beobachtet werden kann. Die Zelle fängt erst an, die charakteristische Volumenzunahme zu durchlaufen. Im Punkte T sollte augenscheinlich eine Kernteilung mit nachheriger Wandbildung stattfinden, die des Röntgenschadens wegen nicht vollführt werden kann. Die Zelle bleibt nach vollendeter Kernteilung ungeteilt und die Zuwachskurve fängt wieder an. Solche »zusammengesetzte» Kurven kamen auch bei mehreren unterdrückten Zellenteilungsversuchen vor.

ZUSAMMENFASSUNG

Bei der Bestrahlung der Alge Mes. caldariorum entstehen mehrkernige Riesenzellen ähnlicher Art wie sie schon an anderen Objekten beobachtet worden sind. Die quantitative Ermittlung dieser Erscheinung ergab ein rasches Ansteigen des maximalen Zellenvolumens mit Röntgendosis bis zu etwa 15 000 r und dann ein flacheres Abfallen der Kurve und wahrscheinlich assymptotische Annäherung an den Normalwert, bei sehr grossen Dosen. Zugleich wurde die Zuwachskurve der Zellen nach der Bestrahlung ermittelt. Dabei ergab sich dass diese bei Dosen bis zu 15 000 r von Normaltypus ist, dagegen bei grösseren Dosen allmählich einen mehr unregelmässigen Verlauf nimmt.

SUMMARY

After radiation of the alga Mes. caldariorum there develop multinucleated giant cells of a type similar to those which have already been observed on other objects. The quantitative determination of this phenomenon showed a rapid increase in the maximum cell volume with a röntgen dose up to about 15,000 r and then a more gradually descending curve and probably asymptomatic approach to the normal value with very large doses. The growth curve of the cells after the radiation was also determined and found to be of normal type with doses up to 15,000 r while with larger doses a more irregular course is gradually adopted.

RÉSUMÉ

L'irradiation de l'algue Mes. caldariorum détermine la production de cellules géantes polynuclées, analogues à celles qui ont été déjà observées sur d'autres objets. L'appréciation quantitative de ce phénomène donne une augmentation rapide du volume des cellules avec des doses de Röntgen jusqu'à env. 15,000 r, après quoi on observe une chute plane de la courbe et vraisemblablement un rapprochement sous forme d'asymptote de la valeur normale pour les très fortes doses. La courbe d'accroissement des cellules s'observe immédiatement après l'irradiation; mais tandis qu'elle reste du type normal jusqu'à 15,000 r, elle prend généralement une forme plus ou moins irrégulière pour les doses plus fortes.

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ÜBER DIE WIRKUNGEN DER RÖNTGENSTRAHLEN AUF ÖSOPHAGUS UND TRACHEA[1]

von

Rolf Bull Engelstad (Drammen, Norwegen).

(Tabulæ LXXXI—LXXXIII)

Ernstere Schädigungen von Ösophagus und Trachea als Folge von Röntgen- oder Radiumbestrahlung scheinen eine seltene Erscheinung zu sein. RAHM berichtet jedoch über einen solchen Schaden im Ösophagus nach Bestrahlung, und GARHAM teilt einen Fall mit, wo im Anschluss an Implantation von »radon seeds» in ein Ösophaguskarzinom Nekrose der Trachea auftrat.

Von experimentellen Untersuchungen liegen meines Wissens nur die im Jahre 1921 von LACASSAGNE publizierten vor. Er nahm seine Untersuchungen an Kaninchen vor und verwendete zur Bestrahlung Platinnadeln, die Tuben mit Radiumemanation enthielten und an der Innenseite des Musculus sternocleidomastoideus derart fixiert wurden, dass sich genau gleichgrosse Abstände zum Ösophagus und zur Trachea ergaben. Er machte im ganzen 2 Versuche; im einen Falle wurden 5.5 M.C.D. von jeder Seite gegeben, im anderen Falle 48 M.C.D. von einer Seite. Nach diesen Bestrahlungen fand er sehr bedeutende degenerative Veränderungen in der Ösophagusschleimhaut, während die Trachealschleimhaut gut erhalten war. Die Beobachtungszeit war in beiden Fällen kurz.

Diese Beobachtung LACASSAGNES steht in guter Übereinstimmung mit anderen experimentellen und therapeutischen Erfahrungen an anderen Organen, u. a. dem Uterus. REGAUD und LACASSAGNE geben deshalb als eine allgemeine Regel an, dass »*les épithéliums de revêtement à cellules prismatiques* sont beaucoup plus réfractaires aux radiations que les épithéliums pavimenteux stratifiés.»

Unser Wissen über die Wirkungen der Röntgen- und Radiumstrahlen auf Ösophagus und Trachea ist indes immer noch ziemlich mangelhaft.

[1] Bei der Redaktion am 22. V. 1934 eingegangen.

Nähere Studien über diese Fragen könnten daher von Interesse sein, und ebenso könnte es bei der so geringen Zahl der Versuche LACASSAGNES begründet sein, diese Untersuchungen über das Verhältnis der Radiosensibilität der Ösophagusschleimhaut zu derjenigen der Trachealschleimhaut an einem grösseren Material zu wiederholen.

Die Kenntnis dieser Verhältnisse hat auch recht grosse praktische Bedeutung bei der Strahlenbehandlung von mediastinalen und anderen intrathorakalen Geschwülsten, und vor allem bei der Behandlung von Ösophaguskarzinomen. Bedient man sich hier einer Kombination von Röntgenbehandlung und endoösophagealer Radiumbehandlung, so wird die die Trachea treffende Dosis ziemlich gross sein können, wenn man eine Sterilisierung der Geschwulst im Ösophagus erreichen will. Es hat deshalb sein grosses Interesse, ins Klare darüber zu kommen, wieviel Bestrahlung von der Tracheaschleimhaut, und wieviel von der Ösophagusschleimhaut vertragen wird, und wie sich diese beiden Werte zur Hautreaktion verhalten.

In einer anderen Versuchsreihe, über die ich in früheren Publikationen berichtet habe, hatte ich Gelegenheit, diese Fragen an einem recht grossen Material zu studieren. Ich nahm hier Röntgenbestrahlungen des Thorax vor, um die Reaktion der Lungen zu untersuchen. Bis auf wenige Ausnahmen wurde ein 6×4 cm grosses Feld der rechten Thoraxhälfte von vorne mit einem Fokus-Hautabstand von 27 cm bestrahlt. Das Feld reichte vorne medialwärts bis zur Mittellinie, es mussten also auch Trachea und Ösophagus in das bestrahlte Gebiet fallen. Da der Abstand zwischen der Schleimhaut im hintersten Teil der Trachea und der Schleimhaut der vordersten Ösophaguspartie nur 2—3 mm beträgt, wird der Dosenunterschied in diesen Gebieten, bei dem hier angewendeten Abstand, minimal. Er wird jedenfalls sicher so klein, dass er bei den hier gebrauchten Dosengrössen keine Bedeutung für die biologische Wirkung bekommt.

Über die Bestrahlungstechnik ist sonst nur noch wenig hinzuzufügen. Es wurden folgende Strahlenqualitäten angewendet: 65 kV, 6 mA, 0 Filter — 65 kV, 6 mA, 1 mm Al—110 kV, 6 mA, 1 mm Al — 175 kV und 4 mA ohne Filter und mit 1 mm Al, $^1/_2$, 1, 2 und 7 mm Cu.

Auch die Grösse der Dosen variierte stark. Ich habe diese Dosen hier wie auch in meinen früheren tierexperimentellen Untersuchungen nach der Hautreaktion in 3 grosse Hauptgruppen eingeteilt:

1. *Die subepidermiziden Dosen* (in diesen Versuchen 1,700 r) rufen keine oder nur eine unbedeutende Hautreaktion hervor.

2. *Die epidermiziden Dosen* (in diesen Versuchen 2,200—6,830 r, je nach den Bestrahlungsbedingungen) haben eine ausgesprochene Röntgenepidermitis zur Folge, die jedoch im Laufe von 4—6 Wochen mit glatten, schönen Narben heilt.

3. *Die gefährlichen oder letalen Dosen* (in diesen Versuchen 9,000—13,500 r) führen im Laufe verhältnismässig kurzer Zeit zum Tode oder verursachen langwierige, heftige Epidermitiden, die — wenn sie heilen — Schrumpfung und Atrophie zurücklassen.

Diese Gruppen sind natürlich nicht scharf getrennt, sondern gehen verschwimmend ineinander über, eine solche Einteilung ist aber gleichwohl völlig berechtigt, weil die Dosen in jeder Gruppe biologische Wirkungen haben, von welchen man sagen kann, dass sie innerhalb derselben Grenzen liegen.

Im ganzen habe ich 58 Tiere untersucht, davon 4 als normale Kontrollen.

Von den bestrahlten Tieren bekamen 10 subepidermizide, 35 epidermizide und 9 gefährliche oder letale Dosen.

Die Bestrahlung wurde in 1—4 Sitzungen mit 24—48stündigen Intervallen gegeben.

Die Versuche gaben folgende Resultate:

In den ersten Tagen nach der Bestrahlung sind die Veränderungen unsicher; in ein paar Fällen findet man allerdings sowohl im Ösophagus als auch in der Trachea Epithelzellen, die den Eindruck machen, als wenn sie etwas geschwollen wären; eine ganz sichere initiale Reaktion war jedoch nicht nachzuweisen.

Erst nach 1—2, bis zu 3 Wochen tritt eine deutliche Reaktion ein, die sich in erster Linie durch degenerative Veränderungen in der Schleimhaut zu erkennen gibt. Die Zellen werden gross und geschwollen, zum Teil vakuolisiert; in der Trachea hat die Zahl der Becherzellen bedeutend zugenommen; dort kommen auch Pyknosen der Kerne vor; es besteht mehr oder weniger lebhafte Desquamation, in einigen Fällen völlige Ablösung der Schleimhaut. Ungefähr gleichzeitig mit dem Beginn der Schleimhautdegeneration, oder gleich nach dieser, tritt auch eine mehr oder weniger lebhafte Leukozyteninfiltration auf. Schon vor dieser, und noch mehr während dieser, findet man vaskuläre Reaktionen, die sehr ausgesprochen sein können, in Form von submuköser Blutüberfüllung und erhöhter Transsudation (Fig. 1).

Diese verschiedenen Prozesse können 2—3 Wochen nach der Bestrahlung mit ziemlich grosser Stärke einsetzen, in der Regel beginnen sie aber ziemlich mässig und nehmen dann im Laufe der ersten Wochen rasch zu. Am ausgesprochensten sind die Veränderungen in der Regel nach 1—2 Monaten, jedenfalls nach epidermiziden und gefährlichen oder letalen Dosen.

Nach subepidermiziden Dosen scheint die Reaktion von kurzer Dauer zu sein. Schon 2 Monate nach der Bestrahlung ist sie nahezu abgelaufen, und nach Verlauf von 3 Monaten findet man nur ganz leichte Bindegewebsneubildung, leichte Epitheldesquamation und zum Teil et-

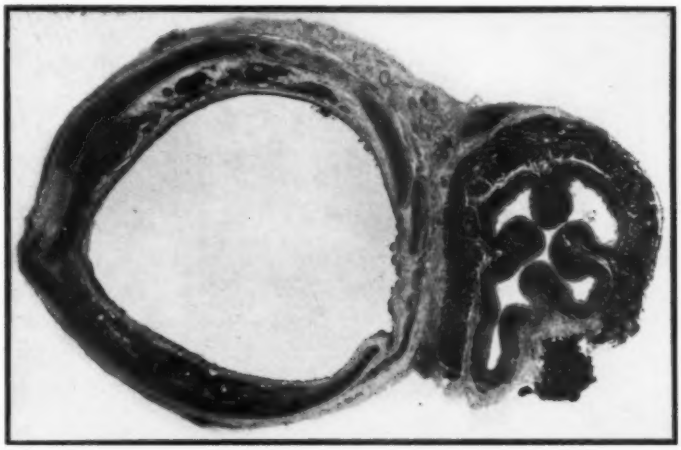

Fig. 1. Bedeutende Blutüberfüllung der Trachealwand. Wenig ausgesprochene Degeneration und Entzündung. 14 Tage nach einer Dosis von 2 200 r. — 15fache Vergrösserung.

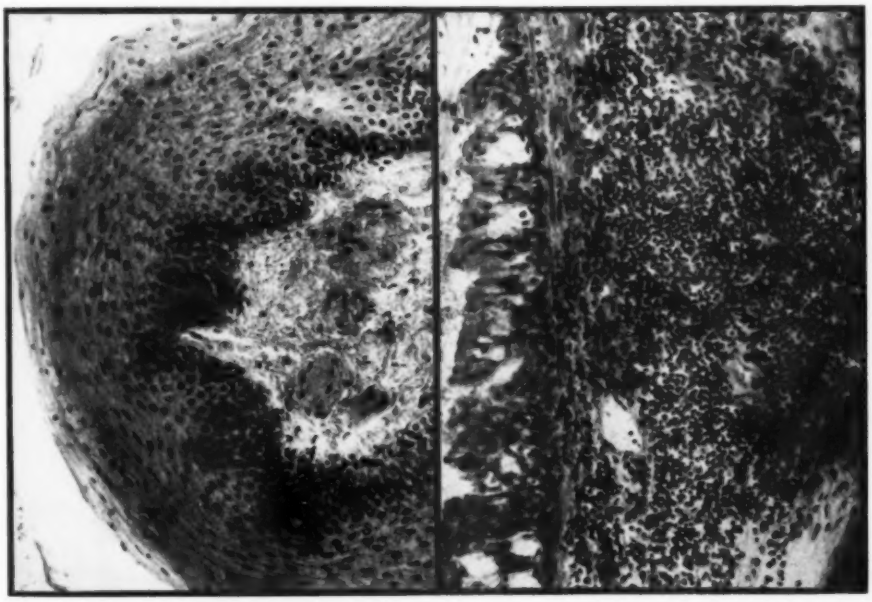

Fig. 2. Schwere Veränderungen in der Trachea, während der Ösophagus nahezu normal ist. 5 Monate nach einer Dosis von 9 000 r. — 27fache Vergrösserung.

Fig. 3. Im Ösophagus vollständige Abstossung der Schleimhaut. Auch in der Trachea bedeutende degenerative Veränderungen. Das Lumen beider Organe enthält ein fibrinöses und zellhaltiges Exsudat. 1 Monat nach einer Dosis von 4 610 r. — 33fache Vergrösserung.

Fig. 4. Bedeutende Schleimhautdegeneration in der Trachea mit monströsen, unregelmässigen Zellformen. 2 Monate nach einer Dosis von 9 000 r. — 150fache Vergrösserung.

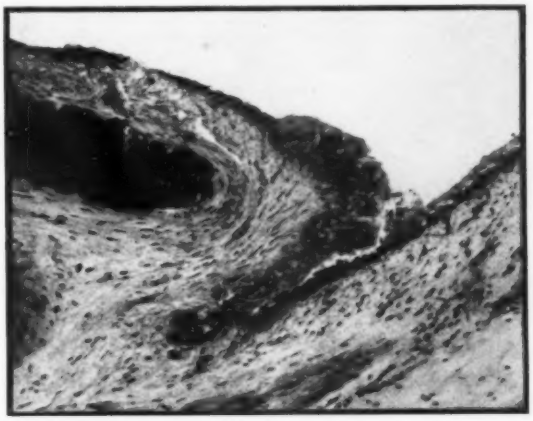

Fig. 5. Trachea 5 Monate nach einer Dosis von 13 500 r. Reste von Epithel, stellenweise mit leichter Proliferation. Teilweise Stratifikation des Epithels. — 130fache Vergrösserung.

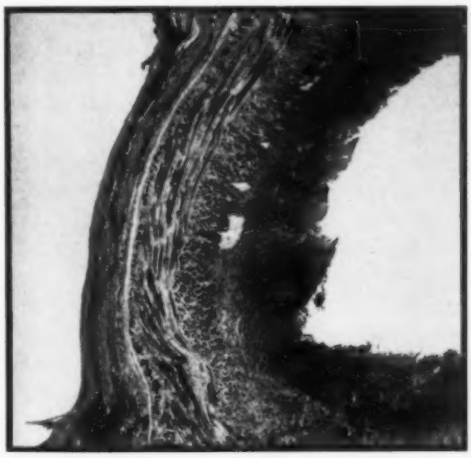

Fig. 6. Schwere Schleimhautdegeneration und Entzündung im Ösophagus. Leicht ausgesprochene Veränderungen in der Trachea. 16 Tage nach einer Dosis von 9 000 r. — 22fache Vergrösserung.

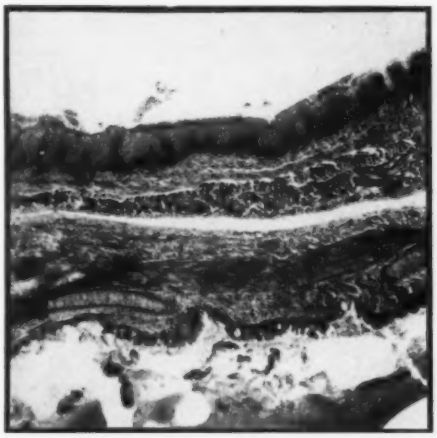

Fig. 7. Die Ösophagusschleimhaut ist fast normal, sehr bedeutende Degeneration in der Trachea. 2 Monate nach einer Dosis von 9 000 r. — 130fache Vergrösserung.

was unregelmässige Zellformen. Nach epidermiziden Dosen nimmt die Reaktion erst 3 Monate nach der Bestrahlung richtig ab. Bei Untersuchung nach 4 und 6 Monaten findet man etwas Bindegewebsneubildung, Epitheldesquamation und unregelmässige Zellformen. In einem vereinzelten Falle bestanden aber selbst nach 6 Monaten ausgesprochene degenerative und entzündliche Veränderungen.

In der Gruppe, die die grössten Dosen erhalten hat, sind noch 5 Monate nach der Bestrahlung Trachealveränderungen schwersten Grades zu konstatieren, während die Reaktion im Ösophagus nahezu abgelaufen ist. (Fig. 2). Auch in den beiden ersterwähnten Gruppen bekommt man den Eindruck, dass die Reaktion in der Trachea beträchtlich länger dauert als im Ösophagus. Was speziell das Epithel betrifft, treten die Veränderungen in der Ösophagusschleimhaut früher auf und haben gewissermassen einen akuteren Verlauf. Nicht selten kommt es hier nach den grossen Dosen binnen kurzer Zeit zu einer mehr oder weniger vollständigen Ablösung der Schleimhaut. Die Innenseite des Ösophagus ist dann von einem fibrinösen Belag bedeckt, der auch einen grossen Teil des Lumens ausfüllen kann (Fig. 3). Ein solches Bild liegt meistens im ersten und zweiten Monat nach der Bestrahlung vor. Später hat die Schleimhaut fast immer ein relativ normales Aussehen. Man erhält den Eindruck, dass die Ösophagusschleimhaut leicht ernstlichen Schaden erleiden kann, dass sie aber auch leicht regeneriert.

Anders verhält es sich mit dem Zylinderepithel der Trachea. Hier setzen die Veränderungen nicht so heftig ein, oft treten sie auch etwas später auf als im Ösophagus. Es dauert aber auch länger, bevor völlige oder annähernde Restitutio ad integrum erreicht wird. Eine mehr oder weniger vollständige Abstossung der Schleimhaut sieht man in der Trachea selten, sie kann aber vorkommen. In den späteren Stadien zeigt die Tracheaschleimhaut oft ganz monströse Zellformen (Fig. 4), ab und zu Stratifikation und in ein paar Fällen leiche Proliferation (Fig. 5).

Abgesehen von den hier erwähnten Unterschieden gestaltet sich die Reaktion in Ösophagus und Trachea ziemlich gleich, so wie sie oben im allgemeinen dargestellt ist. Einen quantitativen Vergleich zwischen den Veränderungen in Ösophagus und Trachea anzustellen, ist selbstverständlich sehr schwer, da er nur auf eine subjektive Schätzung und nicht auf ziffernmässige Werte aufgebaut sein kann. Da ein solcher Vergleich indes von ziemlich grosser Bedeutung ist, habe ich gleichwohl versucht, ihn durchzuführen. Meiner Ansicht sind es die groben, augenfälligen Unterschiede die es Interesse hat nachzuweisen, während eine stark nuancierte Gradierung sowohl biologisch als auch praktisch therapeutisch geringe Bedeutung besitzt. Unter dieser Voraussetzung ist ein solcher Vergleich sehr gut durchführbar.

Bei dieser Untersuchung zeigt sich, dass bei 28 von den Versuchstieren, also bei mehr als der Hälfte, die Veränderungen in Trachea und Ösophagus gleich stark ausgesprochen waren. Bei 17 Tieren sind sie im Ösophagus deutlich ausgesprochener als in der Trachea, und in 9 Fällen verhält es sich umgekehrt. Der Unterschied kann, ob er in die eine oder die andere Richtung geht, sehr erheblich sein, wie es aus einigen von den wiedergegebenen Mikrophotographien hervorgeht. So sind auf Fig. 6 Ösophagusveränderungen schwersten Grades zu sehen, während die Schleimhaut der Trachea ziemlich gut erhalten ist, und auf Fig. 7 sieht man das entgegengesetzte Verhalten deutlich illustriert.

Untersucht man nun, ob diese Unterschiede eine Abhängigkeit von der nach der Bestrahlung verlaufenen Zeit aufweisen, so findet man folgendes recht interessantes Verhalten: Von den 17 Tieren, bei welchen die Veränderungen im Ösophagus stärker sind, lebten nur 2 länger als 2 Monate nach der Bestrahlung. Bei den übrigen 15 überschritt die Beobachtungszeit nicht 2 Monate. Und anderseits: Von den 9 Tieren, bei welchen die Tracheaveränderungen stärker ausgesprochen sind, lebten 3 genau 2 Monate nach der Bestrahlung, die übrigen 6 Tiere länger als 2 Monate. Mit anderen Worten, es ist ein Überwiegen der Ösophagusveränderungen besonders in den beiden ersten Monaten nach der Bestrahlung zu finden, während nach dieser Zeit die Tracheaveränderungen dominierend sind.

Aus den hier referierten Untersuchungen geht hervor, dass der Unterschied zwischen der Radiosensibilität der Ösophagusschleimhaut und derjenigen der Tracheaschleimhaut nicht so gross ist, wie es nach der Untersuchung LACASSAGNES mit Radiumbestrahlung den Eindruck machte. Erstens geht aus meinem Material hervor, dass in mehr als der Hälfte der Fälle kein deutlicher Unterschied in Bezug auf den Grad der Veränderungen in den beiden Organen bestand. Ferner merkt man, dass es eine grosse Rolle für die Resultate spielt, wie lange Zeit zwischen der Bestrahlung und der Vornahme der histologischen Untersuchung verflossen ist.

Indes ergeben auch meine Untersuchungen das Resultat, dass die Ösophagusschleimhaut radiosensibler ist als die Schleimhaut der Trachea. Dies gibt sich wesentlich dadurch zu erkennen, dass die degenérativen und entzündlichen Veränderungen im Ösophagus rascher erscheinen und einen akuteren Verlauf haben. In der Trachea entwickeln sich die Veränderungen in der Regel langsamer, sie sind selten so stürmisch, können aber nach und nach die schwersten Grade erreichen, und es kann lange Zeit verstreichen, bevor der Prozess gänzlich abgelaufen ist. Untersuchungen, die nur in den ersten Tagen oder Wochen nach der Bestrahlung ausgeführt werden, werden daher keinen ganz korrekten

Ausdruck für das Verhältnis zwischen den Veränderungen in den beiden Organen geben.

Als praktisch wichtigstes Resultat dieser Untersuchungen ergab sich: Eine Röntgendosis, die ausgesprochene Veränderungen in der Ösophagusschleimhaut hervorruft, wird auch zu deutlichen oder bedeutenden Veränderungen in der Tracheaschleimhaut führen können, wenn auch das Maximum bei den letzteren Fällen auf einen späteren Zeitpunkt fällt als dasjenige beim Ösophagus.

ZUSAMMENFASSUNG

Röntgenbestrahlung von Ösophagus und Trachea ruft in diesen beiden Organen degenerative und entzündliche Veränderungen hervor, die 1—3 Wochen nach der Bestrahlung deutlich nachweisbar sind. Nach subepidermiziden Dosen ist die Reaktion in der Regel leicht und geht im Laufe von 2—3 Monaten zurück. Nach epidermiziden und nach gefährlichen oder letalen Dosen sind die Veränderungen oft sehr stark, und in manchen Fällen 5—6 Monate nach der Bestrahlung noch nicht abgelaufen. In einzelnen Fällen kommt es zu gänzlicher Abstossung der Schleimhaut und schwerer Entzündung. Die Ösophagusveränderungen treten rascher auf und haben einen akuteren Verlauf, weshalb sie oft in den ersten 2 Monaten das Bild beherrschen, während sich die Trachealveränderungen langsamer entwickeln, länger anhalten und deshalb in den späteren Stadien nicht selten vorwiegen.

Die Ösophagusschleimhaut ist wohl radiosensibler als die Trachealschleimhaut, aber der Unterschied ist sicher nicht so gross, wie man bisher glaubte, und äussert sich zu einem wesentlichen Teil in der verschiedenen Geschwindigkeit, mit der die Reaktion sich entwickelt. Eine Röntgendosis, die deutliche Veränderungen in der Ösophagusschleimhaut hervorruft, wird auch zu deutlichen Veränderungen in der Trachealschleimhaut führen.

SUMMARY

The author describes how roentgen irradiation of the esophagus and trachea in both these organs produce degenerative and inflammatory changes, which become plainly demonstrable in the course of from one to three weeks after the irradiation. After subepidermicide doses the reaction is usually slight, and subsides in the course of two or three months; after epidermicide, and after dangerous or lethal doses, the changes are often very pronounced, and in many cases will not have subsided entirely even after five or six months. Sometimes the mucosal lining peels off completely, and intense inflammation sets in. The changes begin earlier, and develop more acutely, in the esophagus than in the trachea, and therefore frequently, in the former, dominate the picture during the first two months; while in the latter, owing to their slower development and greater persistence, they not seldom preponderate in the later stages.

The esophageal mucosa is undoubtedly more radiosensitive than the tracheal, but the difference is certainly not as great as formerly believed, and expresses itself chiefly in the different speed with which the reaction develops. A roentgen dosis that provokes distinct changes in the mucosa of the esophagus will also produce distinct changes in that of the trachea.

RÉSUMÉ

L'irradiation par les rayons Röntgen de l'œsophage et de la trachée provoque dans ces deux organes des lésions dégénératives et inflammatoires, qui deviennent nettement décelables de une à trois semaines après l'irradiation. Après les doses sub-épidermicides, la réaction est, en règle générale, légère et rétrocède dans un délai de 2 à 3 mois. Après les doses épidermicides, ainsi qu'après les doses dangereuses ou mortelles, les lésions sont très prononcées et persistent, dans bien des cas, de 5 à 6 mois après l'irradiation. Dans quelques cas, elles vont jusqu'à un véritable décollement de la muqueuse avec inflammation grave. Les lésions œsophagiennes sont plus précoces et ont une évolution plus aiguë, et dominent souvent dans les deux premiers mois le tableau histologique, tandis que les lésions trachéales ont une évolution plus lente, se maintiennent plus longtemps et, par suite, prédominent fréquemment dans les stades anciens.

La muqueuse œsophagienne est sans doute plus radiosensible que la muqueuse trachéale, mais la différence de cette radiosensibilité n'est certainement pas aussi marquée qu'on le croyait jusqu'ici, et se traduit en majeure partie par une différence de rapidité de réaction. Une dose de rayons Röntgen qui provoque des lésions nettes de la muqueuse œsophagienne conduit également à des lésions nettes de la muqueuse trachéale.

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FROM THE ROENTGEN DEPARTMENT OF THE ROYAL SERAPHIMER HOSPITAL, STOCKHOLM.
(CHIEF: PROF. GÖSTA FORSSELL)

BONE-FREE RADIOGRAPHY OF THE EYE. A NEW PROJECTION AND A FILM HOLDER[1]

by

Knut Lindblom

(Tabula LXXXIV)

Already in 1896 LEWKOWITSCH and CLARK proposed bone-free radiography of the eye. During the subsequent years several papers were published on the method and the results obtained. The temporo-nasal projection was the only one made use of at that time. In 1907 HAMBURGER advised of a naso-temporal projection, and produced a film holder for the same (the strap of a head mirror, with an arm extended to hold the film). In 1921 VOGT made the next advance by introducing the examination in three dimensions. He used the temporo-nasal projection mentioned above together with a cranio-caudal projection, an entirely new one. VOGT showed that with the aid of this examination it was possible not only to find minute splinters, invisible in other radiographs, but also to locate them. ERB developed the technical side of the VOGT method by constructing a manual film holder (a handle, at one end of which the lead-reinforced film could be attached). HÆMMERLI, WIESER, STOCKER, and others, have subsequently tried the method, and have advised of several cases when the localization was verified.

In spite of this it would appear as if the VOGT method has been little used. The usual thing is that the temporo-nasal projection alone is deemed sufficient, no endeavour to locate any possible foreign bodies being made. STOCKER considers the reason to be that the method is insufficiently known. HOFFMANN, on the other hand, finds the method inexact, though he states no reason for his opinion.

A VOGT examination is carried out in the following manner: A tongue-shaped film (»Oculus» or eye-film, according to VOGT) is inserted as far as possible into the conjunctival sac of the greater canthus, and the beam is directed from the temporal side of the same eye. Another film is placed against the lower eyelid near its free edge, and together with

[1] Submitted for publication May 28th, 1934.

the lower eyelid it is pressed in below the bulb. The exposure is made in a cranio-caudal direction so that the beam touches the supraorbital border. Both the positions may be supplemented by exposures from extreme directions of vision, and thus parts even behind the equator of the eye may be roentgenographed bone-free. A greater part of the cornea is made visible with the aid of an eye speculum. In the event a thorough localization be desired, VOGT, however, advises not to go by the outline of the cornea but to make use of indicators on the cornea or in the limbus.

The foreign bodies which in this manner may be localized bone-free, but cannot be localized transcranially, are the following:

1) minute metal-splinters, and thin lamellar ones which the beam does not strike on the edge only,
2) greatly corroded splinters (siderosis),
3) small splinters of materials of low specific gravities (light metals, common glass, etc.).

Groups 1 and 3 encompass the very splinters that frequently lack sufficient living force to penetrate deep into the tissue. They are often easily accessible for ophthalmological localization. This is, however, seldom the case in and close to the ciliary body. That part is instead a very important sphere for roentgenological localization, especially as the effect of splinters in this part is very deleterious.

Transcranial projections with a negative result thus do not complete a radiography of the eye, should the presence of a foreign body be suspected. The subsequent bone-free examination ought if possible to be made in two planes, and with extreme directions of vision. HOFFMANN's objection that the localization is inexact would appear to lack proof, and is contradicted by the numerous verifications published. The same facts also show that a possible deformation of the bulb due to the pressure of the film has no practical influence on the result, generally at least. If the examination is delayed until a few days after the perforation it is not necessary to calculate with any danger of infection. The disadvantage of using indicators is small, and does not justify an omission to localize, should localization be deemed necessary.

However, when the forehead protrudes very much, and often in other cases, the cranio-caudal projection afore-mentioned gives very little more than the anterior chamber of the eye fairly bone-free. I have therefore endeavoured to replace that projection by another one, a caudo-cranial one. A new improved film holder has also been constructed for bone-free eye-examinations in general.

The conjunctival sac anaesthesized, the film, in the caudo-cranial position, is inserted between the upper eyelid and the bulb. The patient

is told to look »downwards» while this is being done, so as to avoid damaging the cornea. The lesions occasionally occurring in doing so have in all cases been healed within a day without any permanent injury to the eye. — The tube is placed in such a position that the direction of the rays touches the cheek. However, it may occasionally be necessary to expose through the bone and soft tissues of the cheek, when the eyes are deep-set, and the cheek-bones prominent. But in these cases there are never involved so thick layers as in the forehead.

Generally no difficulties are met with in inserting the film deep when the anaesthesizing is good. The width of the film must of course be adjusted to that of the slit of the eye. Having measured the rima of a great number of men and women, I have found that its width usually exceeds 25 mm. However, it is generally possible to insert a dental film 32 mm. wide.[1] Should it be necessary to bend the film, the radius of the bend need not be less than 5 cm. The elongation of the picture will then be less than $^1/_2$ mm., a fault of no practical importance. At a focus distance of 60 cm. the enlargement due to the divergence of the beam may also be neglected.

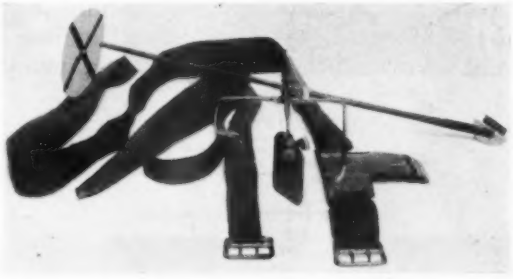

Fig. 1.

The film holder[2] (Fig. 1) consists of two plates connected by a bow. The larger, ⊥-shaped one rests against the forehead, the smaller, ∧-shaped one against the bridge of the nose. The plates are affixed to the head by means of encircling straps. The bow carries a fixation-arrangement movable in three dimensions, which ends in a channel where the film is screwed in. A round disc perforated with letters is rotatable in front of the film. This makes it possible to give the direction of vision on the film direct. When the direction of vision is cranial CR is turned forward, when to the left S, straight ahead O, etc.

A fixation disc, carried by a wooden rod 30 cm. long, may also be attached to the bow. The rod is fixed to a side-scale, the graduation being arranged so that a point at the place for the eye is the centre.

[1] A preliminary agreement has been made with the Agfa works who have held out the prospect of manufacturing a dental film, size 25 × 35 mm.

[2] Manufacturer: Ingeniörsfirma G. Schönander, Stockholm 5.

Figures 2 and 3 show a caudo-cranial and a temporo-nasal position respectively. The radiographs reproduced in fig. 4 were taken as follows: A with the former position, and B—D with the latter, C and D with an extreme direction of vision downwards and upwards. In A and B the picture of the eye is bone-free up to 14—15 mm. behind the vertex corneæ, in C and D as far as 20 mm. The borders of the cornea (the arrows) may be distinguished without indicators. In this case no foreign body could be shown.

The radiographs E and F were taken in a case where the foreign body was invisible but to a bone-free radiography. E is the picture obtained caudo-cranially, F the one temporo-nasally. With the aid of a pattern of a »normal-bulb» (AHLBOM) it was easy to decide the position of the foreign body. The corneal outline of the pattern was displaced until it covered the cornea in the radiograph. In E (Fig. 5) the distance

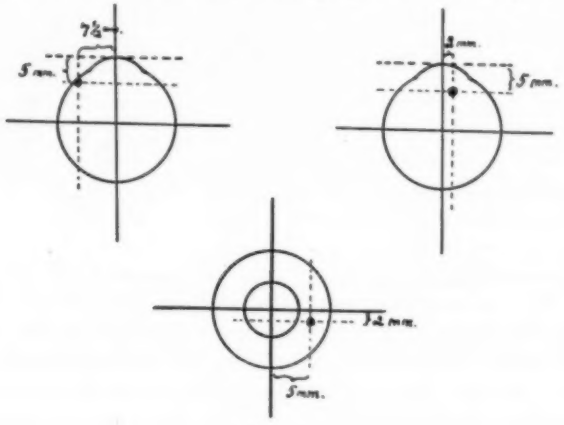

Fig. 5.

from the splinter was measured to a sagittal plane through the vertex corneæ ($7^1/_2$ mm.), and the distance to the frontal plane through the vertex (5 mm.). In F the distance was measured in the same manner from the splinter to the horizontal plane through the vertex (2 mm.). Presuming that the shape and size of the bulb were normal, the distance of the splinter was calculated at $11^1/_2$ mm. from the centre of the bulb. (For further details vide AHLBOM). It must thus be in or close to the sclera, by the ciliary body to be more exact. In this case it was possible to verify the localization by means of exploratory traction with the magnet, as the patient had a sore feeling in the corresponding place. And an episcleral transillumination disclosed a dark spot on the wall. As the splinter had been there for six years without irritating the eye very considerably, no extraction was performed.

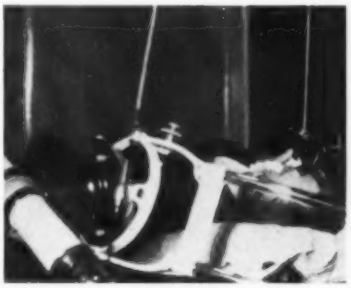

Fig. 2.

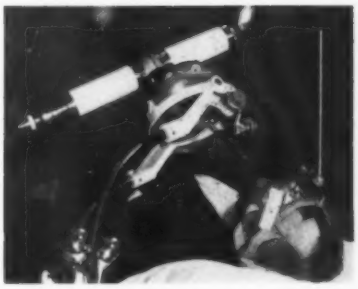

Fig. 3.

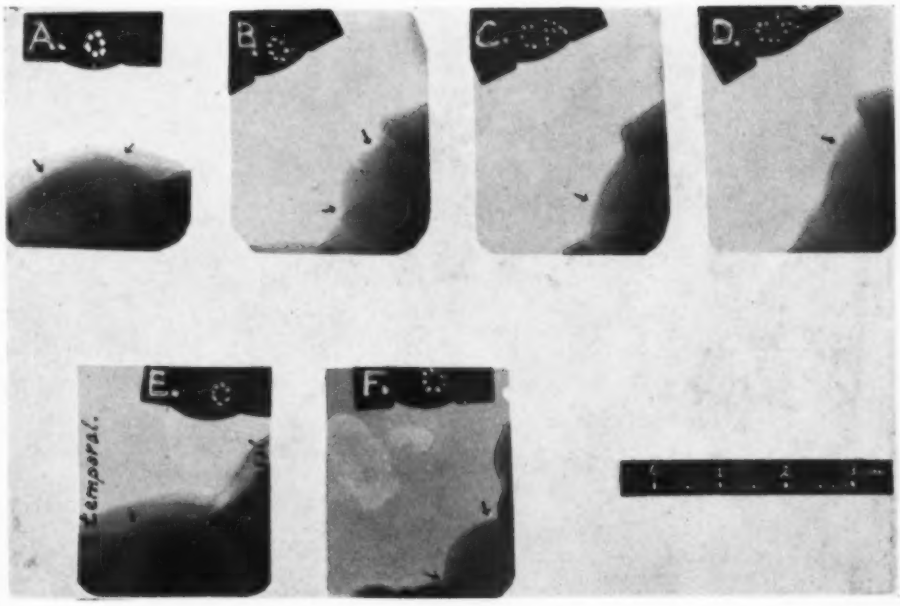

Fig. 4.

SUMMARY

The writer describes a film holder for bone-free radiography of the eye, and a new, caudo-cranial projection for the same purpose, supplementing the projections previously used. The bone-free examination in two planes with localization ought always to be made in cases when a foreign body is suspected in the eye, and the result of the transcranial examination has been negative.

ZUSAMMENFASSUNG

Verf. beschreibt einen Filmhalter für skelettfreie Röntgenuntersuchung des Auges und eine neue, kaudo-kraniale Projektion für denselben Zweck, wodurch die früher angewendeten Projektionen ergänzt werden. Die skelettfreie Untersuchung in zwei Ebenen mit Lokalisation soll immer vorgenommen werden, wenn Verdacht auf einen Fremdkörper im Auge besteht und die transkraniale Untersuchung ein negatives Resultat gegeben hatte.

RÉSUMÉ

L'auteur décrit un porte-pellicule pour l'examen radiologique de l'œil avec élimination du squelette, ainsi qu'une nouvelle projection caudo-cranienne destinée au même but, qui complète les projections antérieurement utilisées.

On doit toujours recourir à l'examen sans squelette sur deux plans avec localisation dans tous les cas où l'çon soupçonne la présence d'un corps étranger dans l'œil et où l'examen transcranien est resté négatif.

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FROM THE ROENTGEN DEPARTMENT OF THE ROYAL SERAPHIMER HOSPITAL, STOCKHOLM.
CHIEF: PROF. GÖSTA FORSSELL

SECONDARY SCREENING BY MEANS OF FILTERING[1]

by

Knut Lindblom

(Tabula LXXXV)

One of the most important conditions in order to obtain a good Röntgen-picture is, that the secondary radiation be reduced to a minimum. The first method for the achievement of such an improvement of the picture was found at an early date, very much thanks to the work of ALBERS-SCHÖNBERG. That method, primary screening and compression, involved a reduction of the volume of the body exposed to the rays, and thus a proportional decrease of secondary radiation. There followed — more than 10 years later — BUCKY's discovery of grid screening. In this case a metal grid inserted between the body exposed to the rays and the light-sensitive film effectively absorbed the oblique secondary rays. New constructions and improvements on this method have been made by ÅKERLUND, LYSHOLM, and others. Another way of preventing the secondary rays from reaching the sensitive film was later evolved by GROEDEL and LAURELL, i. e. to remove the sensitive film so far from the body exposed to the rays that the oblique secondary rays go outside the surface where the reproduction is obtained. In order to simplify the description this method will here be called distance screening.

It has also been found, empirically, that a metal-filter placed as is a grid-diaphragm flat between the body exposed to the rays and the light-sensitive film brings about an improved Röntgenpicture. This was emphasized by THORAEUS. The main reason would appear to be that secondary radiation on an average is softer than primary radiation, and is thus subjected to greater absorption in the filter. — THORAEUS calls a filter of this kind a secondary filter, to differ it from one inserted in the primary beam.

[1] Submitted for publication May 28th, 1934.

Thus far we find plenty of information in the literature on the subject, but there is not much to be read regarding comparative examinations of the various diaphragms. It has been left to individual experience to decide which diaphragm may be considered to give the best results under ordinary working conditions. Thus LAURELL in the »Svensk förening för Medicinsk Radiologi» (1932) expressed as his opinion, based on practical examinations, that when high voltage was used secondary filters (in this case Sn + Pb) give better results than thin grid-diaphragms. In another paper of a later date LAURELL published the results of an investigation showing that the contrasts in the picture become intensified when secondary filters are used. On the other hand he did not at that time publish any results of comparative investigations between secondary filters and other secondary diaphragms.

Simultaneous with LAURELL the writer read a paper on the results of his own previous investigations in this sphere. The comparison has later been extended so as to include several different types of grid-diaphragms and several secondary filters. No corresponding investigation of the effect of primary diaphragms (and compression) has been made, however, as it is the opinion of the writer that — on account of the different point of attack — primary screening is more suitable to support the other methods than to compete with them.

The aim of these examinations has been to find out the screening capacity of secondary filters compared with that of other secondary screening arrangements, also to ascertain the effect of the filter material on the screening capacity, and finally the possible advantages and disadvantages of secondary filters.

The writer has used as secondary filters foils of 0.5 mm. Al, 0.04 mm. Cu, 0.01 and 0.02 mm. Sn, and in one case 0.04 mm. Ag and 0.04 mm. Pb. From the grid-diaphragms available were selected a flat POTTER-BUCKY-diaphragm, an ÅKERLUND-diaphragm, a stationary and a movable LYSHOLM-diaphragm, and a movable diaphragm (LINDBLOM-SCHÖNANDER) consisting of two crossed LYSHOLM-diaphragms. Distance screening was achieved by moving the body exposed to the rays 8 and 30 cm. respectively from the film, the focus-film-distance being constant (1 m.). All measurements were taken photographically, not ionometrically, in order to copy ordinary Röntgen examinations as closely as possible. *Intensifying foils were not used, as the front foil intensifies and creates secondary filtering at the same time* (equal to approx. 0.1 mm. Sn.). The examinations were performed without the aid of ordinary aluminium-cassettes, for the same reason. The film was enclosed in paper only.

The first radiographs were of a waxbody (25 × 16 × 4.5 cm.). Fig. 1. On the upper surface of the body, i. e. that towards the tube, there

was placed a narrow strip of lead (A), and part of the film lying under the body was shaded by the same, and thus exposed to secondary rays only. In taking the pictures the above mentioned arrangements for secondary screening were used one by one. The voltage was varied from 40 to 90 kilovolt peak (3-phase-apparatus, Tridoros). The number of mA-seconds was empirically selected in such a manner as to attain very much the same degree of film-darkening for each and every exposure. The darkening was measured with a densimeter (Zeiss), firstly in the shadow of the strip of lead (A) mentioned, and secondly in the vicinity where the film had been exposed to both primary and secondary radiation. One edge of the film was protected against both primary and secondary radiation by means of another strip of lead, B. The film-darkening for B, the fogging, was for each film subtracted from the values obtained for the other darkenings. This correction being made they were called Sd (secondary darkening), and Sd + Pd (secondary + primary darkening), respectively. The quotient Pd : Sd was then obtained, and this quotient was considered as a final measure of the secondary screening. The quotients were entered in a graph, plotted against the voltages.

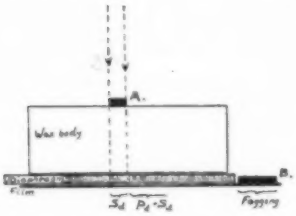

Fig. 1.

Fig. 2 gives a graphical picture of the connection thus found between the corresponding values for Pd : Sd and the voltage. Each separate curve refers to one of the diaphragms with the exception of the bottom one, which is the result of a test without a secondary diaphragm. The upper curves, I—VI, show the screening qualities of grid-diaphragms and great distance screening (30 cm.). They form a group far removed from the other curves, and are comparatively close to each other. The lower curves, VII—XII, show the effects of short distance screening (8 cm.), secondary filtering, and no secondary screening. As do the upper ones, also these curves form a group of their own with the curves close to each other compared with the great gap to the upper group. As will be seen, no great change in this respect occurs when a change of voltage is made. It is thus evident that within the entire sphere of voltage used in Röntgen diagnostic none of the secondary filters used can match the grid-diaphragms with regard to effect.

As will be seen from fig. 2 the secondary screening capacity of 0.020 is greater than that of 0.010 mm. Sn. By further increasing the thickness of the tin-foil an increase in effect would probably be secured, but this can be done only with an additional loss of primary radiation. On taking a picture of the stationary LYSHOLM-diaphragm and tin-foils,

placed side by side without any body creating secondary radiation, the writer obtained a film-darkening with 0.02 mm. Sn approximately corresponding to that obtained with the LYSHOLM-diaphragm. The weakening of the primary radiation is thus the same in 0.02 mm. Sn and in the LYSHOLM-diaphragm, whereas the diagram in Fig. 2 shows that the secondary screening capacity is 2 : 7. The fact that it is not

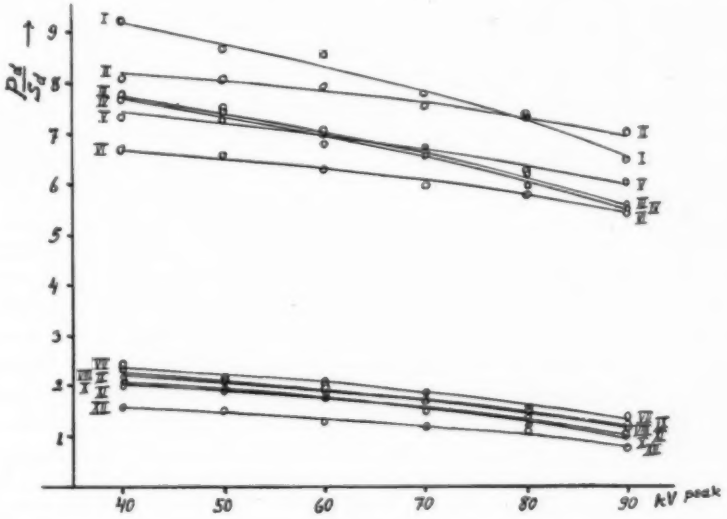

Fig. 2.

I. Crossed LYSHOLM diaphragms.
II. POTTER-BUCKY diaphragm.
III. Movable LYSHOLM diaphragm.
IV. Stationary LYSHOLM diaphragm.
V. ÅKERLUND diaphragm.
VI. Distance 30 cm.
VII. Distance 8 cm.
VIII. Cu 0.04 mm.
IX. Sn 0.02 mm.
X. Al 0.5 mm.
XI. Sn 0.01 mm.
XII. No secondary diaphragm.

the distance screening (the thickness of the LYSHOLM-diaphragm is $^1/_2$ cm.) but the grid-screening that causes this difference is apparent from curve VII of the same diagram, which shows that the effect of distance screening at 8 cm. is small in comparison to what is obtained by means of the LYSHOLM-diaphragm.

It will, however, be found that if the thickness of the filter is increased from 0.01 to 0.02 mm. Sn (Curves XI and IX), this duplication of the thickness of the filter does not cause a corresponding increase in the secondary screening but a considerably smaller one. With 60 kilovolt, for instance, we find that the Pd : Sd without secondary screening is 1.2, with 0.01 mm. Sn 1.7 (difference 0.5), and with 0.02 mm. Sn 1.9

(difference 0.2). This indicates that the secondary screening that may be obtained by means of secondary filtering mainly occurs in a very thin layer of the filter. If a minimum loss of primary radiation combined with maximum secondary screening be desired, comparatively thin layers ought to be made use of. The writer has put the practical maximum limit at 0.02 mm. Sn, or a filter holding equally good absorption qualities.

It is further apparent from the examinations above referred to (Fig. 2) that approximately the same secondary screening effect may be obtained with 0.5 mm. Al and 0.01 mm. Sn, also with 0.04 mm. Cu and 0.02 mm. Sn. The type of filter material is thus — within certain limits — of no importance for the secondary filtering itself. On taking pictures of the secondary filters with the primary beam direct it appeared that the absorption of primary radiation, as apparent from the decreased film-darkening, was the same for the Al-foil and the thin Sn-foil as for the Cu-foil and the thick Sn-foil. Seeing that the secondary filtering in two metals may be made equal, and the weakening of the primary rays will be equal in the two secondary filters, it is apparently of no practical value — from this viewpoint — what metal the filter be made of.

There is, however, a considerable difference between the light metals on the one hand, and the semi-heavy and heavy ones on the other. It is known that when in immediate contact with the film-surface the latter intensify the darkening of the film due to the emission of characteristic radiation (and secondary electrons). This intensification and its effect on the secondary screening were subjected to examinations with a similar testing apparatus as in Fig. 1. Strips of an Sn-foil were placed close to the film, on the upper surface $\left(\frac{\text{Sn}}{\text{O}}\right)$ and on the lower one $\left(\frac{\text{O}}{\text{Sn}}\right)$, as well as on both sides of the film $\left(\frac{\text{Sn}}{\text{Sn}}\right)$. The strips were put lengthwise at right angles to the length of the strip of lead acting as a primary diaphragm (A in Fig. 1). Pd : Sd was decided in the same manner as previously described, now within $\frac{\text{Sn}}{\text{O}}$, $\frac{\text{O}}{\text{Sn}}$, $\frac{\text{Sn}}{\text{Sn}}$, and $\frac{\text{O}}{\text{O}}$ (the latter being a sphere where there was no Sn-foil whatsoever, neither filtering nor intensifying). The values obtained for Pd : Sd (Fig. 3) were found to agree with each other entirely in the two cases of filtering $\left(\frac{\text{Sn}}{\text{O}} \text{ and } \frac{\text{Sn}}{\text{Sn}}\right)$ as well as in the two cases without filtering $\left(\frac{\text{O}}{\text{Sn}} \text{ and } \frac{\text{O}}{\text{O}}\right)$. The intensifying Sn-foil thus had no effect upon the secondary screening, and the intensification due to the filtering-foil ought not to do so either. — The increase

in darkering of the Sn-foil on the bottom side of the film was measured and found to be 8 %.

Whereas the intensification is an advantage with the heavy metals, the absorption edges may theoretically be a counterbalancing disadvantage. For at these edges there is a sudden change in the absorption capacity, creating difficulties with regard to the choice of exposure conditions. Such absorption-jumps occur with several of the heavy metals within the sphere of the Röntgen diagnostic wavelengths, thus for Sn at 0.42 Å units (corresponding to approx. 60 kilovolt), and for Ag at 0.49 Å units (corresponding to approx. 40 kilovolt).

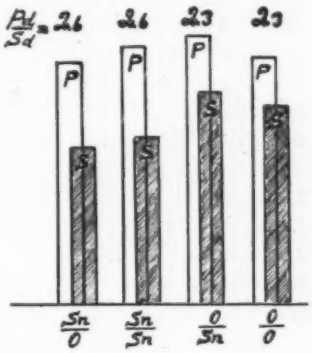

Fig. 3.

In order to investigate the importance of the absorption edges foils of Ag and Sn were selected, and to obtain a comparison also of Al, Cu and Pb. These foils were radiographed at 32—64 kilovolt peak, the current being supplied by a 1-phase-(diagnostic)-apparatus with four valves. The type of tube used was Multix, Al being used as primary filter. Measurements of the darkenings were taken with a densimeter, and the values obtained entered in a graph (Fig. 4). The changes anticipated in the values for Ag at 40 kilovolt and for Sn at 60 kilovolt did not appear, however, thus indicating that in these tests at least the absorption edges are of no practical importance.

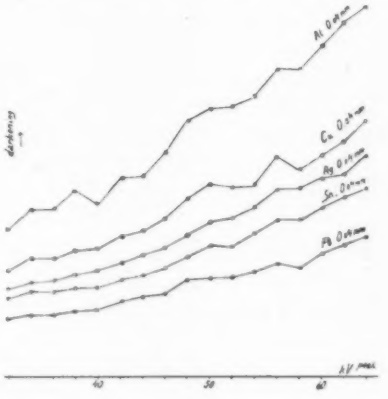

Fig. 4.

There remains still another examination to be accounted for; regarding the sharpness of the outlines when using different kinds of secondary screening. With the aid of a 10 kW Multix-tube with a focus-film-distance of 1 meter pictures were taken of a grate consisting of 0.2 mm. wire. The grate, the secondary diaphragm, and the film were in contact with each other. The pictures obtained of the grate are reproduced in Fig. 5. The secondary filter used for A_1 and A_2 was 0.02 mm. Sn, Sn-intensification also being used for the former. A_3 lacks both filter and intensification. A crossed LYSHOLM-

diaphragm was used for B, and C was taken with a single movable LYSHOLM-diaphragm. The diaphragms were 1 cm. thick. D was taken with an ÅKERLUND-diaphragm. And in E, finally, the grate was placed at a distance of 30 cm. from the film. It will be seen that in A—C the sharpness is complete (even when enlarged four times). The sharpness is not quite complete in D, as may be seen with the naked eye even, and the E-picture lacks sharpness entirely.

The fact that the thin grid-diaphragms do not diffuse the sharpness of outline any more than do the secondary filters still more limits the compass within which the latter may legitimately be used as substitutes. The result is that in such cases when grid-diaphragms are unsuitable from a practical point of view, but in no other cases, we must keep in mind that secondary filtering can improve the result, though not very considerably. *When working with the film enclosed in an aluminium cassette or when intensifying screens are used, an additional metal-layer for filtering is of no great value.*

At the Röntgen Department of the Serafimer Hospital there has since December 1931 been used a special cassette for the taking of pictures without intensifying screens. The front of the cassette consists of $^1/_2$ mm. Al as usual, and there is a copper-plate close to the back of the film acting as an intensifying screen. This arrangement has proved quite satisfactory. It has not been necessary to increase the time of exposure very considerably, as the intensifying arrangement has compensated for part of the loss of radiation in the filter itself. It is, however, desirable that a heavy metal be used instead of aluminium. This in order to obtain a more completely compensating intensification. This has hitherto met with practical difficulties with reference to the wear of the cassette, as such a metal-layer must be very thin.

Fig. 6 indicates how completely this intensification can compensate the loss of darkening by filtration. The whole picture was taken at one exposure. The bottom right hand square lacked both secondary filtering and intensification, but for the top left hand square there was a foil of 0.01 mm. Sn on both sides of the film. The exposure through the soft tissues is equally good in both pictures, but there is a great difference in the darkenings of the bone tissues.

SUMMARY

The writer has made comparative examinations of secondary filters and other secondary diaphragms, and found as follows:

Secondary filters are far inferior to grid-diaphragms with regard to their secondary screening capacity but in this respect they are of the same use as short distance screening. Both light and heavy metals make suitable secondary filters. In addition to their filtering effects the heavier metals have an intensifying effect which may be used to com-

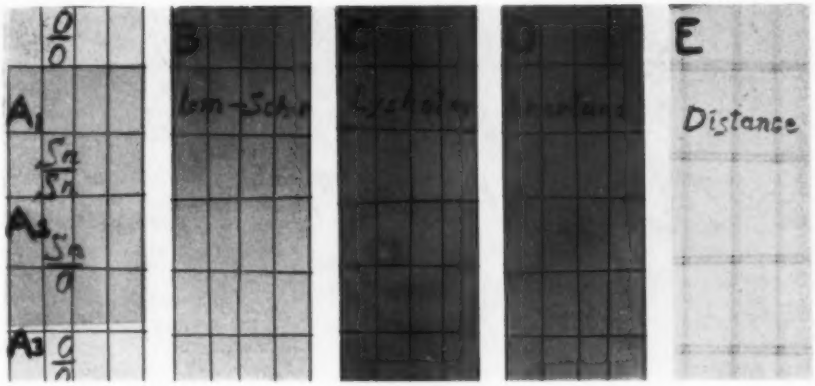

Fig. 5.

Fig. 6.

pensate the loss of darkening. Secondary filters and thin grid-diaphragms do not detrimentally affect the sharpness of outline. Secondary filters and intensification by means of metal foils improve the results when radiographs are taken without intensifying screens.

ZUSAMMENFASSUNG

Verf. stellte vergleichende Untersuchungen zwischen Sekundärfiltern und anderen Sekundärblenden an und fand dabei folgendes:

Die Sekundärfilter stehen in Bezug auf das Vermögen der Sekundärabblendung weitaus hinter den Rasterblenden zurück, sind aber diesbezüglich ebenso wirksam als kurze Abstandsblendung.

Leichte und schwere Metalle sind als Sekundärfilter gleich verwendbar. Die schwereren Metalle haben ausser der filtrierenden auch eine verstärkende Wirkung, die zur Ausgleichung des Schwärzungsverlustes benutzt werden kann.

Sekundärfilter und dünne Rasterblenden wirken nicht verschlechternd auf die Konturschärfe ein.

Sekundärfilter und Verstärkung durch Metallfolien verbessern das Resultat bei Aufnahmen ohne Verstärkungsschirme.

RÉSUMÉ

L'auteur a fait des examens comparatifs entre le filtre secondaire et les autres diaphragmes secondaires et il est parvenu aux conclusions suivantes:

Le filtre secondaire est incomparablement inférieur au diaphragme à grille en ce qui concerne le pouvoir diaphragmateur secondaire, mais il rend les mêmes services qu'une diaphragmation à faible distance.

Les métaux légers et les métaux lourds sont tout aussi utilisables comme filtres secondaires. Les métaux lourds ont, en plus de leur pouvoir filtrant, un effet renforçateur que l'on peut utiliser pour compenser la perte de noircissement.

Les filtres secondaires et les grilles minces n'influent pas sur la netteté des contours.

Le filtre secondaire et le renforcement par feuilles de métal améliorent les résultats dans les photographies dans écrans renforçateurs.

LITERATURE

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FROM THE ROENTGEN DEPARTMENT OF THE SERAPHIMER HOSPITAL, STOCKHOLM.
(CHIEF: PROFESSOR GÖSTA FORSSELL)

INTRACRANIAL CALCIFICATIONS[1]

by

Torleif Dale, Oslo

(Tabulæ LXXXVI—LXXXVIII)

Intracranial calcifications are fairly often seen on radiograms. Every intracranial calcified deposit is the result of a regressive process arisen in consequence of some necrotic change in the tissues. It is a deposit of phosphates and carbonates of calcium in the same proportion as found in the skeleton.

A great many of these calcifications are found where there are no definite signs of any intracranial diseased conditions; this group has therefore been called *physiological* calcifications. Other calcifications are caused by *pathological* processes, the most important of which are *brain tumours* and next to come *inflammatory* and *traumatic* changes.

The roentgen literature pertaining to these conditions is relatively scanty. The fundamental work was published by STRØM in 1921 on the basis of material collected from the Roentgen Department of the Seraphimer Hospital. Since then, besides some smaller contributions, 3 larger works have been published in the course of the last few years, in 1930 by COURVILLE and ADELSTEIN, by BOENING, and in 1932 by LÖW-BEER.

My cases have been drawn from the Roentgen Department of the Seraphimer Hospital kindly placed at my disposal by Professor GÖSTA FORSSELL, to whom my respectful thanks are due. The brain tumours to be referred to later have all been operated on by Dr. OLIVECRONA who has kindly permitted me to refer to his operative findings; for this I wish to bring him my sincere thanks. Likewise I wish to thank Professor N. ANTONI for permitting me to make use of the material of the Nerve Clinic.

The most frequent physiological calcification is doubtless *calcification of the pineal body*. These cases I am not taking up for consideration here as B. LILJA is dealing with this class of calcifications and their importance in the present number of Acta Radiologica.

[1] Submitted for publication May 28th, 1934.

Next in frequency after calcification of the pineal body is that of the *plexus chorioideus*. These calcifications generally appear as annular little dense shadows where the posterior cornu passes into the lower cornu of the lateral ventricle. The lime deposits are found in endothelial cells which are the seat of hyaline degeneration and arranged in concentric annular layers. On lateral skiagrams the calcifications are projected at the same level as the pineal body or somewhat lower and one or two millimetres further dorsally. In antero-posterior pictures they are projected paramedially at the same distance from the midline if present on both sides. The distribution of the calcifications may, however, vary considerably, and they may also appear on one side only. In most cases the appearance is characteristic enough to leave out any doubt. For definite localization in atypical cases it is necessary to do ventriculography. Fig. 1 shows an ordinary plexus calcification in an antero-posterior projection. In a sagittal projection (Fig. 2) the calcifications are seen furthest down in the air-filled lateral ventricles. Judging from the cases I have dealt with, however, there is nothing definite to indicate that these circumscribed calcifications localized to the glomus can be accorded any pathological importance. The material has shown, however, that they occur exceedingly often, far more often than formerly assumed. All previous publications pf plexus calcifications submit only cases with calcifications of the lateral ventricles. Yet DYKE and DAVIDOFF in a recent publication mention that occasionally calcifications may also be met with in the plexus of the third ventricle. In my clinical material I have in 3 cases found *calcification of the plexus of the fourth ventricle* in connection also with calcification of the 3rd and lateral ventricles. This calcification of the 4th ventricle, not earlier described, will no doubt, with the present improved technique, be more often met with in the future. — A knowledge of plexus calcifications is of importance not only for the differential diagnosis but also in view of the indirect clues that a displaced calcification may yield in the presence of tumour. This importance will surely become greater in the future since calcifications will be more frequently discovered. Fig. 3 and 4 show complete calcification of the plexus in a woman, aged 61, who suffered from paralysis agitans and chronic nephritis. Moreover there are also abundant calcifications of the arachnoid.

Calcification of the falx cerebri also frequently occurs, chiefly visible on antero-posterior pictures, symmetrically developed on both sides of the median plane a little behind the frontal bone. Fig. 5 shows a displacement of the calcification of the falx cerebri as a result of traumatic haemorrhage.

Calcifications of the attachment of the tentorium are often seen. They are only in evidence on lateral pictures and appear as parallel linear

stripes extending more or less backwards from the dorsum of the sella. Fig. 6 shows an instance of calcification of the tentorium. From the point of view of differential diagnosis calcification of the blood vessels in this region has to be considered, as also meningeoma of the clivus where the opposite bone outline upwards may appear as a stripe-shaped shadow.

Rarely described roentgenologically are *calcifications of the Pacchionian granulations*. Fig. 7 and 8. Stereoscopic lateral pictures settle the diagnosis.

Among pathological intracranial calcifications calcified tumours are from practical standpoint the most important. Calcification of a brain tumour is the most important direct sign in an ordinary routine roentgen examination of the skull. In what follows it will be clear, however, that *the calcification never yields any definite information regarding the size of the tumour and rarely regarding its nature*. It is often necessary therefore to combine an ordinary roentgen examination with ventriculography, maybe also with arteriography, in order to decide whether the calcification is due to some tumour and in that case determine its size. The demonstration of calcifications will thus in the first place be an important guide to further examination.

Among the intra- and suprasellar tumours *cysts of the hypophyseal duct* are the first ones to undergo calcification. Roentgenologically these have a characteristic appearance both with regard to the calcification itself and the changes present in the sella turcica. Fig. 9 shows a characteristic, round, well-defined shadow above and in the entrance to the dilated sella. At the operation one found a cyst, about the size of a hen-egg, with a calcified node, as large as a hazelnut, above the entrance to the sella. In the next case (Fig. 10) the calcifications are more mottled and irregularly arranged. At the operation was found, besides a calcified tumour, the size of a hazelnut, under the right optic nerve a thin-walled cyst, the size of a hen-egg, extending to the left in the middle fossa of the skull.

However, supra- or intrasellar calcifications are not absolutely characteristic only for cysts of the hypophyseal duct. Adenoma of the hypophysis, glioma of the chiasma and of the 3rd ventricle and probably a dermoid cyst belong to the cases in my material which have presented intra- and suprasellar calcifications respectively. Here follow two cases in illustration: Fig. 11 shows a blurred opacity, about the size of a hazelnut, above the floor of the hindpart of the anterior fossa with corresponding distinct excavation of the bone. At the operation was found under the chiasma a tumour, the size of a hazelnut, which on puncture proved to contain cholestearin crystals and small calcium particles.

Microscopical examination showed a probable glioma. Fig. 12 with two intrasellar calcifications proved on operation to be probably a glioma filling out the 3rd ventricle. The roentgen diagnosis here was cyst of the hypophyseal duct.

Judging from earlier roentgen literature calcification of the *glioma* was rarely found. So does STRØM in 1921 refer only to two cases published up till then. The larger and better clinical material available in the last few years has considerably increased the number of cases.

Among my cases I have found 9 calcified gliomata verified by operation. In addition to these there were 4 cases of calcified tumours with the probable microscopical diagnosis of glioma.

Fig. 13 shows a conglomeration of calcium shadows in the occipital region slightly to the right of the midline. At the operation the tumour was felt as a stony hard lump, as large as a hen-egg, in the hemisphere. Histologically the tumour proved to be a very *vascular glioma* with calcification spread in the tissue, partly localized to the vascular wall, partly in the form of free rounded concentrically arranged granules. Fig. 14 shows a fairly widespread mottled calcification in the left anterior fossa of the skull. Corresponding to the calcification there is obvious rarefaction of the bone. At the operation was found a grey-red tumour, the size of a goose-egg, and a cyst of similar size, occupying most of the front aspect of the left anterior lobe. Microscopical examination showed an *oligodendroglioma* with widespread calcifications, mostly localized to the vessel wall in and around the tumour. The next case, also this an *oligodendroglioma*, shows a similar structure in the calcium shadow and similar density (Fig. 15). On operation was found a tumour, the size of a goose-egg, in the right occipital lobe with calcifications in the vessel wall in and around the tumour.

Fig. 16 shows a distinct difference in the structure and localization of the calcium shadow as compared with the two previous cases In the homogeneous shadow there are tortuous clarifications partly extending between small offshoots beyond the densest area. On operation was found *an angioblastic meningeoma with a calcified focus located close to the lateral ventricle.*

Fig. 17 shows a rare type of intracranial calcification. Besides the sharply defined rounded shadow laterally in the left frontal lobe there is medially an indication of an annular shadow quite the size of a tangerine. The operative finding was a very rare one, an *echinococcal cyst*, large as an orange, which was removed. Roentgenologically one did not venture beforehand on any other diagnosis than a calcified tumour.

Fig. 18 shows a sharply defined calcium shadow of somewhat irregular density and the size of a hazelnut, its location corresponding to the right Sylvian fissure. There were dilated grooves corresponding to the

middle meningeal artery. An arteriogram (Fig. 19) shows considerably dilated branches of the middle meningeal artery on the right side projected in front and above the calcification. On operation was found an *arterio-venous aneurysm* which was removed with favourable result. The roentgen appearance is to some extent characteristic; what clinched the diagnosis, however, was the *arteriogram*.

In addition to the calcification types mentioned above, solitary or multiple lime deposits are also found in the skull which are considered due to inflammatory or traumatic changes. As these cases are rarely subjected to operation, it is impossible to be sure of the diagnostic value of this finding without having had available a large post-mortem material, roentgenologically examined.

In the case to be finally related (Fig. 20) the calcification is assumed due to tuberculoma, this assumption being partly based upon the history and partly on account of the appearance. STRØM drew attention to the garland-shaped bounding line around the conglomeration of unevenly densified calcium shadows. By the support of an operated case and cases earlier published he rightly lays stress of this as characteristic of calcified tuberculoma. Fig. 20 is that of a girl, aged 7, with tuberculous strain and epilepsy. The garland-shaped contours are clearly in evidence in both the calcified cases.

The roentgenology of the skull has in recent years taken rapid strides ahead qualitatively and as a result of this also quantitatively. By the standardised technique of projection and the perfect way by which scattered rays can be shut off, the modern radiogram of the skull yields much more information and from a diagnostic point of view much more valuable data than formerly.

Through an improved technique and the larger number of cases available for examination intracranial calcifications have in fact come to possess a much greater significance. It is for that reason I thought it might be of interest to draw attention to the various types of cranial calcifications met with.

SUMMARY

The various types of calcification are discussed in case history form with röntgen pictures.

1. Physiological calcification: The pineal body, the choriod plexus, the falx cerebri, the attachment of the tentorium and the Pacchionian granulations.

2. Pathological calcification: Tumors, Cysts of the hypophyseal duct, 2 cases, gliomas, nine cases, verified by operation and four probable cases. An angioblastic meningioma, an angioma and an ecchinococcal cyst conclude the discussion of verified cases of calcified tumors.

One case of calcified arterio-venous aneurysm diagnosed by arteriogram and cured by operation is described.

In conclusion, post-traumatic, multiple areas of calcification and calcified tuberculomas are mentioned.

ZUSAMMENFASSUNG

Verf. erörtert in Form von Krankengeschichten mit Röntgenbildern die verschiedenen Verkalkungstypen.

1. Physiologische Verkalkung: Zirbeldrüse, Plexus chorioidei, Falx cerebri, Ansatz des Tentoriums und die Pacchionischen Granulationen.

2. Pathologische Verkalkung: Tumoren, Zysten im Hypophysengang, 2 Fälle; Gliome, 9 durch Operation verifizierte und 4 wahrscheinliche Fälle. Ein angioblastisches Meningiom, ein Angiom und eine Ecchinokokkuszyste schliesst die Erörterung verifizierter Fälle von verkalkten Tumoren.

Ferner wird ein Fall von verkalktem arteriovenösem Aneurysma beschrieben, das durch Arteriogramm diagnostiziert und durch Operation geheilt wurde.

Zum Schlusse sind posttraumatische, multiple Verkalkungsgebiete und verkalkte Tuberkulome erwähnt.

RÉSUMÉ

L'auteur discute les divers types de calcification dans des cas où il a été fait des radiographies.

1. Calcification physiologique: glande pinéale, plexus choroïdes, faux du cerveau, insertions du tectorium et granulations de Pacchioni.

2. Calcifications pathologiques: Tumeurs, kystes de l'hypophyse (2 cas), gliomes (9 cas vérifiés par l'opération et 4 cas probables). La discussion aborde en terminant un cas de méningiome angioblastique, un cas d'angiome et un cas de kyste à échinocoques, constituant autant de cas de tumeurs calcifiées confirmées.

L'auteur décrit un cas d'anévrysme artério-veineux calcifié, diagnostiqué par artériogramme et guéri par opération.

Il mentionne enfin en terminant des champs multiples de calcification post-traumatiques ainsi que des tuberculomes calcifiés.

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Tabula LXXXVI.

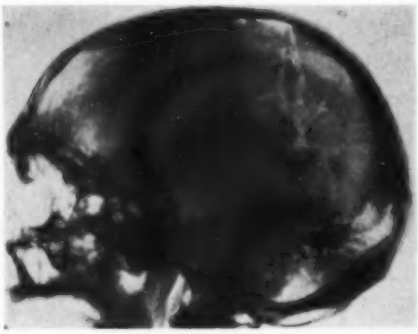
Fig. 1. Calcification of glomus chorioideus.
Fig. 2. Calcification of glomus chorioideus. Lateral ventricles air-filled.
Fig. 3. Complete calcification of plexus chorioideus.
Fig. 4. Complete calcification of plexus chorioideus.
Fig. 5. Calcification of falx cerebri displaced on account of traumatic haemorrhage.
Fig. 6. Calcification in attachment of tentorium.
Fig. 7. Calcification of Pacchionian granulations.

Tabula LXXXVII.

Fig. 8. Calcification of Pacchionian granulations.
Fig. 9. Calcification of cyst of hypophyseal duct.
Fig. 10. Calcification of cyst of hypophyseal duct.
Fig. 11. Calcification of glioma below chiasm.
Fig. 12. Calcification of glioma filling out the 3rd ventricle.
Fig. 13. Calcified vascular glioma.
Fig. 14. Calcification of oligodendroglioma.

Tabula LXXXVIII.

Fig. 15. Calcification of oligodendroglioma.
Fig. 16. Calcification of angioblastic meningeoma.
Fig. 17. Echinococcal cyst in left frontal lobe.
Fig. 18. Calcified arterio-venous aneurysm.
Fig. 19. Arteriogram of arterio-venous aneurysm.
Fig. 20. Calcified tuberculomata.



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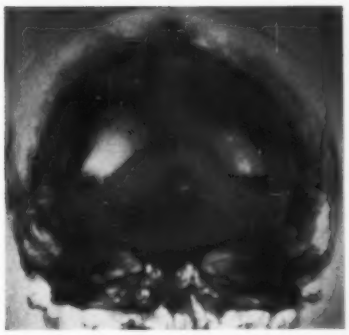

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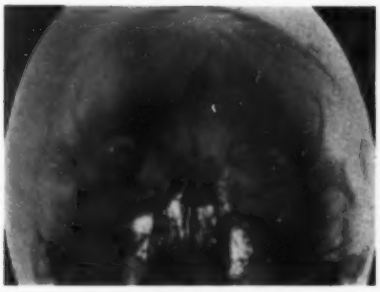

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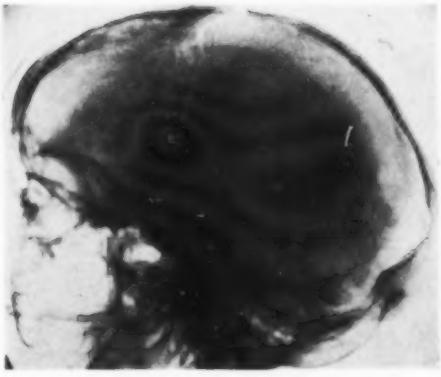

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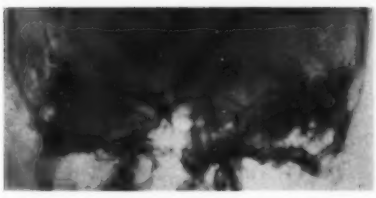

Fig. 5.

Fig. 6.

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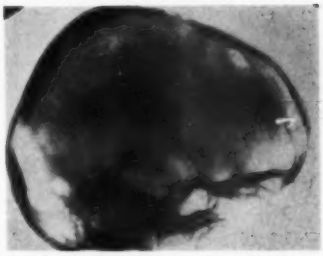

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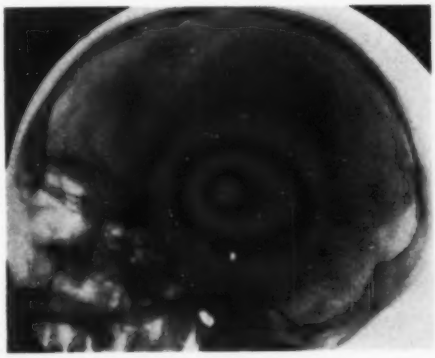

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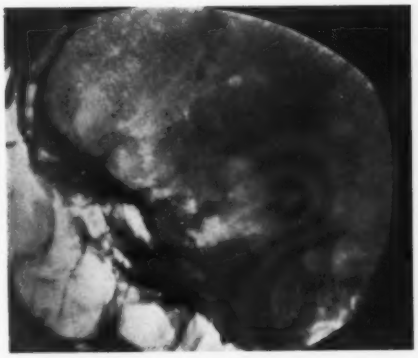

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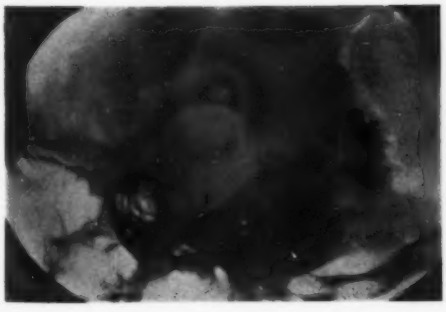

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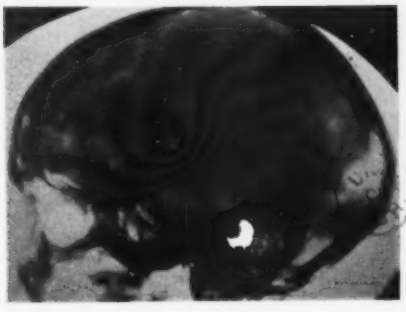

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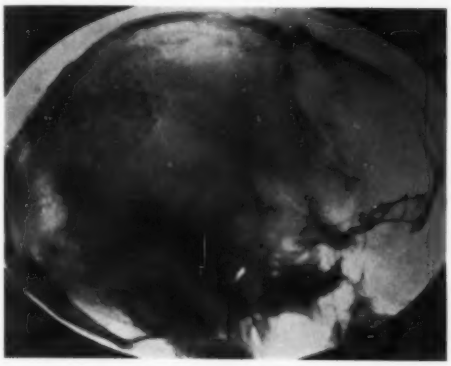

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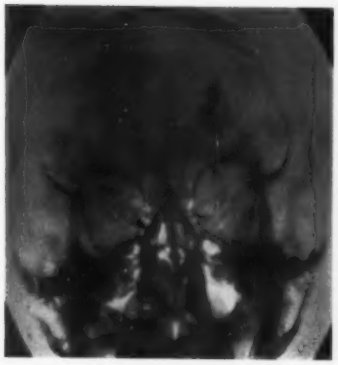

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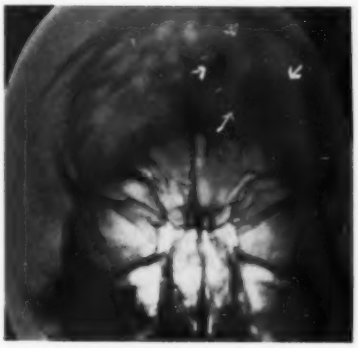

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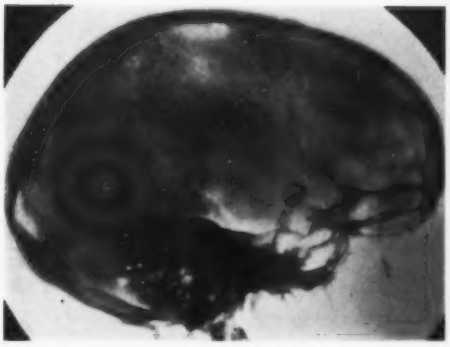

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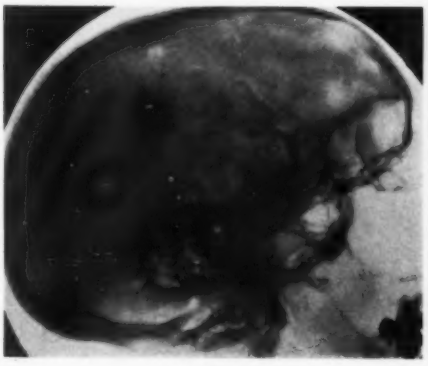

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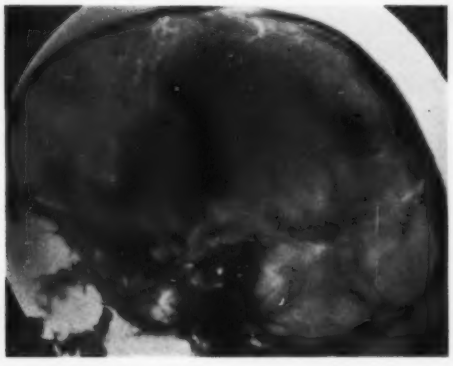

Fig. 20.

FROM THE FIRST MEDICAL CLINIC (CHIEF: PROF. I. HOLMGREN) AND THE ROENTGEN DEPT (CHIEF: PROF. G. FORSSELL) OF THE ROYAL SERAPHIMER HOSPITAL, STOCKHOLM

A NEW ROENTGENOLOGICAL METHOD OF PANCREAS EXAMINATION AND ITS PRACTICAL RESULTS[1]

by

A. Engel and *E. Lysholm*

(Tabula LXXXIX—XCII)

In a previous work (1) we gave an account of the clinical picture of cancer of the pancreas with special reference to its different characters according to whether the tumour is located in the head or the corpus cauda of the pancreas.

The difference in the symptomatology was first, and, we think best, formulated by CHAUFFARD (2) who suggested the terms *»syndrome pancréatico-biliaire»* and *»syndrome pancréatico-solaire»*. The first of these two symptomatic pictures, the painless icterus, constantly progressing when the growth is located in the head of the pancreas, is well-known. On the other hand the segmental and paroxystic pains arising when the growth is located in the corpus cauda — the *»syndrome pancréatico-solaire»* — are not perhaps sufficiently recognised as an early symptom and one of importance for the differential diagnosis. One of the main objects of our above-mentioned paper was to elucidate this symptomatic picture by some clinical cases and thus to establish a better knowledge of its diagnostic importance.

We therefore made a special selection of 13 cases of cancer of the pancreas (of which 11 were verified by autopsy). It may be said that this material comprised all those cases of cancer of the pancreas observed by us, that had not presented the syndrome of »pancréatico-biliaire», that is cases of icterus without pains were consequently eliminated. There were thus 9 cases with the »syndrome pancréatico-solaire», of whom 4 with very well-marked segmental pains. In the remaining 5 cases this syndrome was not well-marked, yet the cases did not belong to the icterus group.

[1] Submitted for publication May 28th, 1934.

As a whole it may be said that in the cases presenting the symptomatic picture just mentioned, the cancer was localised to the corpus-cauda parts of the pancreas. In certain cases, however, the growth was located in the head of the gland. Considering that the common bile-duct runs in close proximity to the descending part of the duodenum it may be possible for an expansive process within the caput to attain in certain situations a considerable size without causing obstruction of the choledochus. From this it also follows that before such an event has arisen the process is able to influence the solar plexus. And this organ, with the immediate adjacency to the pancreas is generally held to be the origin of the irradiating pains characterizing the »syndrome pancréatico-solaire» (CHAUFFARD, LERICHE (3). In relation to these syndromes, therefore, the caput and the corpus cauda of the pancreas should not be considered in a strictly anatomical sense.

In the same paper we subjected the roentgenological findings in pancreatic cancer to critical examination, on the basis of cases observed and verified at the Seraphimer Hospital.

There is no doubt that the conditions for roentgenological diagnostics in pancreatic cancer are very unfavourable. The new growths often consist of scirrhous carcinomata not producing any enlargement or deformity. Up to the present, apart from some experiments with inflation of the peritoneal cavity (GROSS and others) one has been confined to the study of indirect symptoms, namely deformities and other reactions of surrounding organs. The following are the changes of that nature that we generally found in roentgen examination of the stomach and duodenum with barium meal and which are recorded in our above mentioned paper.

1) Deformity of the duodenum with the formation of a wide, C-shaped loop, often with retarded emptying.

2) Displacement and infiltration of the pyloric canal.

Anatomical facts make it at once clear that the conditions for producing the roentgenological changes mentioned are really only present in tumours of the head of the pancreas.

With the view to enabling the pancreas itself to be observed on the radiogram and thereby ascertaining volumetric changes also of the corpus-cauda region, we have now elaborated the following method submitted for the first time in the above-mentioned paper.

Technique

The patient is examined on empty stomach after a preliminary cleaning enema. He is then given an ordinary effervescing powder with a mouthful of vichy water and told not to belch.

With the patient in prone position a lateral picture is at once taken, fig. 1, immediately followed by one in the antero-posterior direction. It is of importance to make the exposures very quickly after the patient has swallowed the powder. If too much carbon dioxide escapes into the small intestine, it will prevent the proper estimation of the size of the pancreatic shadow by this being obscured by the gas bubbles. It

Fig. 1.

is also of course important always to work at the same focal distance; this amounted in our cases to 100 cm. for the lateral and to 140 cm. for the antero-posterior pictures. It is also advisable not to allow the abdomen to abut directly against the couch.

Lateral	*Antero-posterior*
Distance 100 cm.	Distance 140 cm.
Ma 80	Ma 80
kV 75—80	kV 65—70
Time 2—4 sec.	Time 1.5—3 sec.
Tube 10 kW	Tube 10 kW
Raster diaphragm	Raster diaphragm.

On a lateral picture of a normal individual the stomach is then seen to be markedly distended by gas and on its dorsal aspect a triangular shadow is seen filling out the angle between the body of the stomach and the pyloric canal, being bounded behind by the spine (tabula I, fig. 4). If this radiogram is compared with a frozen anatomical section the site

of this shadow will be found to correspond with the pancreas fig. 2 and 3. The pancreas forms here the posterior wall of the bursa omentalis and is situated immediately behind the posterior wall of the body and the pyloric canal of the stomach. An enlargement of mainly the corpus cauda parts of the pancreas will therefore become evident as a displacement in a ventral direction of the above-mentioned parts of the stomach and as an enlargement of the opacity between the stomach and the spine corresponding to the lengthwise projected pancreas. In this examination the advantages of the negative contrast (gas) will be fully borne out. Thus may be seen bulging into the gas-filled stomach soft parts such as tumorous nodules or other convex surfaces.

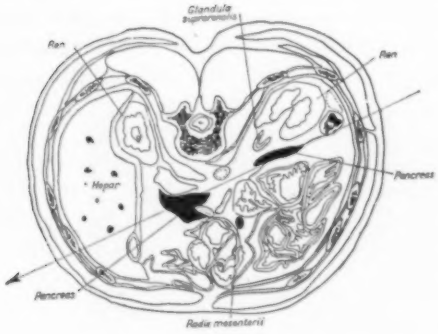

Fig. 2.

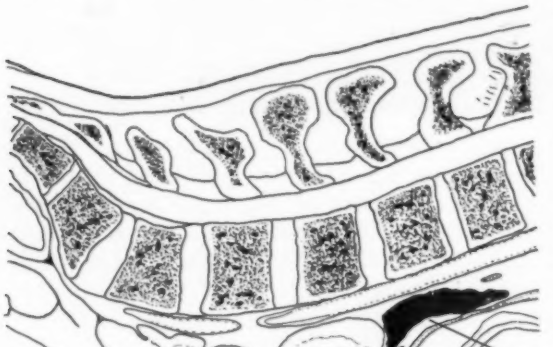

Fig. 3.

An antero-posterior view does not reveal the pancreas but since the upper border of the corpus cauda approximately corresponds to the transition between the fornix and the corpus of the stomach, an increase in volume of these parts may be expected just here to make a depression into that organ. This assumption has been confirmed in several of our verified cases of pancreatic tumours.

With the view of investigating the variations existing in the soft-part shadow observed at the site of the pancreas on lateral skiagrams 29 normal cases were examined by roentgen; in 23 of these cases we found that the size of this shadow

amounted to the breadth of the corresponding corpus vertebrae. In 3 cases it was considerably larger and in the remaining cases one was unable definitely to estimate its size at the first examination wherefore it became necessary to make a reexamination.

During the 18 months passed since our preliminary communication we have made use of the above technique in 30 cases of clinically suspected pancreatic affections. Below will follow an account of these cases in addition to another 3 to which we referred in our first paper. This makes it 33 cases in all, from which, however, we must deduct 3, in which the diagnosis was never fully established (one positive and two negative cases so far the roentgen appearance of the pancreas was concerned). There thus remain 30 cases.

The radiographic appearance in cases without clinical evidence of pancreatic disease

In this groupe there were 11 cases of other abdominal affections and in all of them the radiographic appearance of the pancreas was negative. In 3 cases the clinical diagnosis was verified through operation and in 8 cases continued observation settled the diagnosis as of non-pancreatic nature. Below will follow a list of the various conditions found which may be of interest from the viewpoint of differential diagnosis.

Name	*Age*	*Diagnosis*
P.E.	46	Chronic cholecystitis. Gastroduodenitis. Spondylitis deformans. Neurasthenia.
F.A.A.	65	Ventral hernia in scar after cholecystectomy.
L.	52	Diabetes mellitus. Acute hepatitis.
J.F.	57	Postoperative disorders after resection for gastric ulcer.
P.L.	48	Spastic colitis. Neurosis.
O.B.F.	47	Duodenal ulcer. Polyposis ventriculi.
J.E.K.	53	Alveolar pyorrhoea. Subacid gastritis.
A.A.	30	Hematemesis. Gastric ulcer.
L.H.M.	54	Cancer coli (verified through operation).
S.R.M.V.	43	Cancer of the stomach (verified through operation).
N.E.A.	50	Infarction of omentum (verified through operation).

In four further cases (cases 1—4) we considered the skiagram showed enlargement of the pancreas but the clinical study was unable to give any definite support to the diagnosis of pancreatic disease, and in 2 of the cases we had to regard this as unlikely. In all these 4 cases it was a question of stout persons with a short and broad thorax, that constitutional type, in whom we find the horizontally situated short type of stomach (»Stierhornsmagen», FABER's type I). In all these cases there was no suspicion of cancer, the differential diagnosis being pancreatitis.

In examination undertaken for the sake of the differential diagnosis we thus obtained the following results:

1) In abdominal affections which further observation showed not to be localised to the pancreas, negative results were obtained in all the 11 cases, i. e. the appearance agreed with that observed in the normal cases.

2) In 4 cases, on the other hand, of a certain constitutional type, i. e. stout emphysematous subjects, enlargement of the pancreatic region was observed without any definite clinical signs of pancreatic disease being present. Although in two of these cases we do not feel justified in excluding such a condition, we nevertheless consider it likely that the enlargement here is due to the special topography of the stomach and to increase of the subperitoneal fat. A few control examinations carried out on such subjects with healthy abdomens have in fact showed similar conditions.

C a s e 1. K., J. R. V., born 1878, farmer. Med. Clin. I. 171/1934. Cholecystotomy 1909 or 1910. Cholecystectomy 1923. Abdominal trouble ever since. To the right in the abdomen severe non-radiating aching pains accompanied by a feeling of distress. Abdomen distended. Defecation irregular, generally every second day, hard and loose stools admixed.

Jan. 13—19, 1934 admitted to the surgical clinic here. *Diagnosis.* — Chronic pancreatitis.

Condition Jan. 23. Well covered. Abdomen: Some tenderness in the right flank. *Liver* not palpable. Sedimentation rate 10 mm./1st hour.

Evald's test meal: Achylia.

Exploration of duodenum by probe: Enterococci obtained in the bile before as well as after injection of $MgSO_4$.

Schmidt-Strassburger's testmeal: Stools semi-solid, unformed, iodophil substance and clostridia, plenty of fatty acid crystals in glacial acetic acid preparations, occasional fatty drops and striped muscular fibres.

Roentgen report Jan. 15. After inflation of the stomach a large soft-part tumour is seen to stand at the site of the pancreas and displacing the stomach forwards. The distance between the spine and the tumour shadow is at least the breadth of two corpus vertebrae instead of normally that of one. No concretions can be detected within the altered region. (Pancreatic enlargement.)

After-examined Feb. 28. Roentgen status quo. *Faeces:* grey. Moderate amount of neutral fat and plenty of iodophil substance.

After-examined April 9. Pains to the right in the abdomen and in the epigastrium persist; they are not radiating and are much less marked than before. Bowels open daily, occasionally at most twice a day, always formed. S. R. 4 mm/1st hour.

Abdomen. Soft and not tender.

Faeces. Fairly solid brown balls. No mucus. Weber's test negative. No muscular fibres, iodophil bacteria or substance, sparing amount of neutral fat and fatty acid needles.

Roentgen report April 9. Shadow reduced?

D i a g n o s i s. Achylia gastrica. Chronic colitis. Diverticulum of colon. Post-operative condition after cholecystectomy. Chronic pancreatitis?

Case 2. H., P. R., born 1896. Surg. Clin. 103/1934. Cholecystectomy in 1930 on account of chronic calcareous cholecystitis. Already 3 weeks after the operation, however, attacks of pains recurred to the right of the epigastrium and out towards the back; vomiting, fever and icterus. The individual attack lasted from a few hours to a day. Twice admitted to the Seraphimer Hospital for similar attacks, the last time Jan. 9—20, 1934. Both times icterus was present. On the last occasion diastase in the urine was 64 during the acute stage and the tenderness was confined to the pancreatic region wherefore exacerbated *chronic pancreatitis* was diagnosed. The *presence of gall-stones*, however, could *not* be *excluded* (SÖDERLUND).

Roentgen report Jan. 11. After inflation of the stomach the distance between this and the spine is found to be increased fairly much at the site of the pancreas. There are no shadows suspicious of concretions visible at the site of the pancreas.

On afterexamination. April 6 patient felt in excellent health.

Roentgen report April 6. Appearance unaltered.

Case 3. I., A. A., born 1881, merchant. Surg. Clin. 192/1934 and Med. Clin. II 161/1934.

Since Christmas 1933 he felt slack, tired and weak. On Jan. 13 1934 he began to feel chilly, did not take the temperature. Not until a couple of days later did he develop aching pains of a persistent non-radiating type, besides tenderness in the right flank causing him difficulty to lie on that side. Jan. 17 icterus. Was first admitted to the Surg. Clin. (Jan. 18) and later transferred to the Med. Clin. II. While in hospital he developed well-marked icterus and an enlarged liver. Highest diastase value in urine 40. The highest figure of the sedimentation reaction was 17 mm. during the first hour. Temperature was slightly subfebrile-afebrile.

Jan. 23. Oral cholecystography. Gall-bladder does not fill up. Icterus and liver enlargement disappearing. *Feb. 17. Oral cholecystography.* Gall-bladder well filled up and without defects. Normal emptying.

Roentgen report Jan. 26. The distance between the spine and the posterior wall of the stomach is about twice the normal wherefore the roentgen examination indicates an expansive process localised to the region behind the lower part of the body part of the stomach (pancreatic cyst)?

On *after-examination* April 10 patient was in an excellent condition and nothing pathological could be found.

Roentgen report April 10. Appearance unaltered.

Any other *diagnosis* but *acute hepatitis* does not seem to us to be indicated in this case.

Case 4. F., Hj. V., born 1876. Med. Clin. II. 165/1934. Case of infection causa incert. with fever, increased sedimentation reaction and splenic enlargement without indications of any affection of the liver, bileducts or pancreas.

On *after-examination* April 7 quite well but plenty of striped muscle fibres were observed in the stools.

Roentgen report Feb. 6. The distance between the spine and the posterior wall of the stomach is equal to at least the breadth of two vertebral bodies.

Roentgen report April 7 1934. Appearance unaltered.

Cases of cancer of the pancreas

Cancer is the only form of pancreatic new growth we have had the opportunity of investigating. There are 10 of these cases of whom all

but one have been verified by laparotomy or post-mortem examination. This patient is still alive but the clinical course has raised no doubts as to the correct diagnosis.

When by the roentgenological method related above changes in volume and shape of the pancreas are registrated it is à priori obvious that this method will yield the most useful information in the case of new growths. Owing to the presumably great frequency of scirrhous growths we had expected at first to be relatively often unable to demonstrate any enlargement of the pancreas. Against expectation, however, such enlargement was found in all the cases. With increasing numbers of investigations this will probably have to be modified.

In this group of cases we have found a diagnostic possibility of importance, namely the demonstration of local depressions into the inflated stomach, indicating localised tumour formations of smaller size. Observations of this nature will of course render more reliable the estimation of the changes as pathological and will yield important information regarding their nature. Cases 5, 9 and 11 serve to illustrate this point.

Of the 9 verified cases 3 were localised to the head, two of which presented the »syndrome pancréatico-biliaire» (5 and 6).

Four cases were localised to the corpus cauda, 3 of whom (cases 9, 11 and 12) presented the clinical picture of »syndrome pancréatico-solaire».

In addition there were two intermediary cases (7 and 8) in which the growth probably commenced in the caput. The clinical picture was here initiated by the »syndrome pancréatico-solaire» but this was relatively soon followed by icterus; thus has been present the sequel of events in the case of tumours of the head indicated in the introduction. In 4 cases the growth was palpable at the roentgen examination but not so in the remaining 5 cases in spite of generally repeated examinations.

It will be seen therefore that this method is useful not only for localising a palpable abdominal growth to the pancreasregion but also for demonstrating and localising non-palpable retroperitoneal tumours. It is thus a valuable adjunct to our otherwise so scanty resources in the diagnosis of pancreatic cancer and would therefore seem deserving of greater use in cases of allied nature.

Of course retroperitoneal tumours in the neighbourhood of pancreas can not be differentiated from real pancreatic tumours. A renal tumour must be excluded. Recently we had a case of hypernephroma which produced a confusing picture.

Case 5. W., E. A., born 1898, mechanical fitter. Med. Clin. I. 608, 846, 1147/1932, 117/1933.

Diagnosis. Cancer pancreatis (caput).

Was admitted the first time, June 24, 1932, after having been ill for 10 weeks with symptoms of fatigue, gradually increasing icterus, diarrhoea and marked emaciation.

Fig. 4. Normal pancreas.

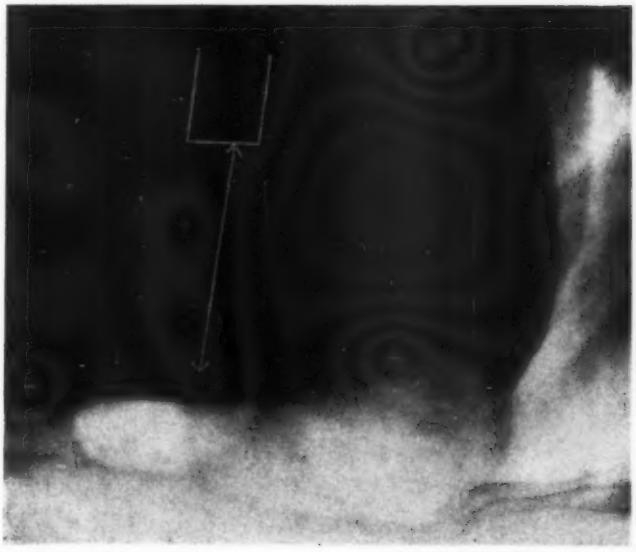

Fig. 5. Note the large soft part shadow bulging in to the dorsal wall of the stomach.

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Fig.
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Fig. 6. Tumor indicated by arrows.

Fig. 7. Frontal view. Nodules bulging into the gasfilled stomach.

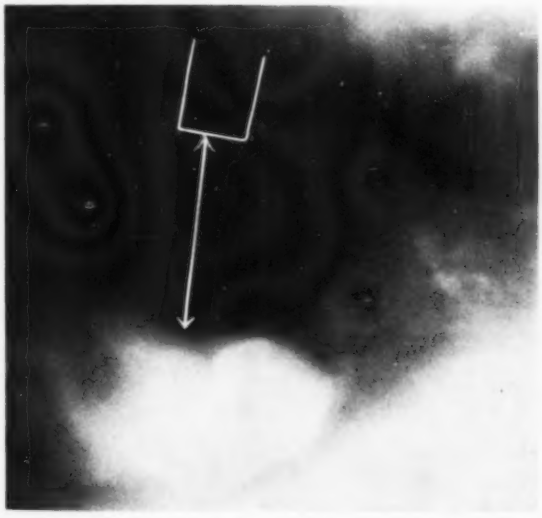

Fig. 8. Soft part shadow of the pancreatic region measuring the breath of two vertebral bodies.

Fig. 9. Big pancreatic tumour.

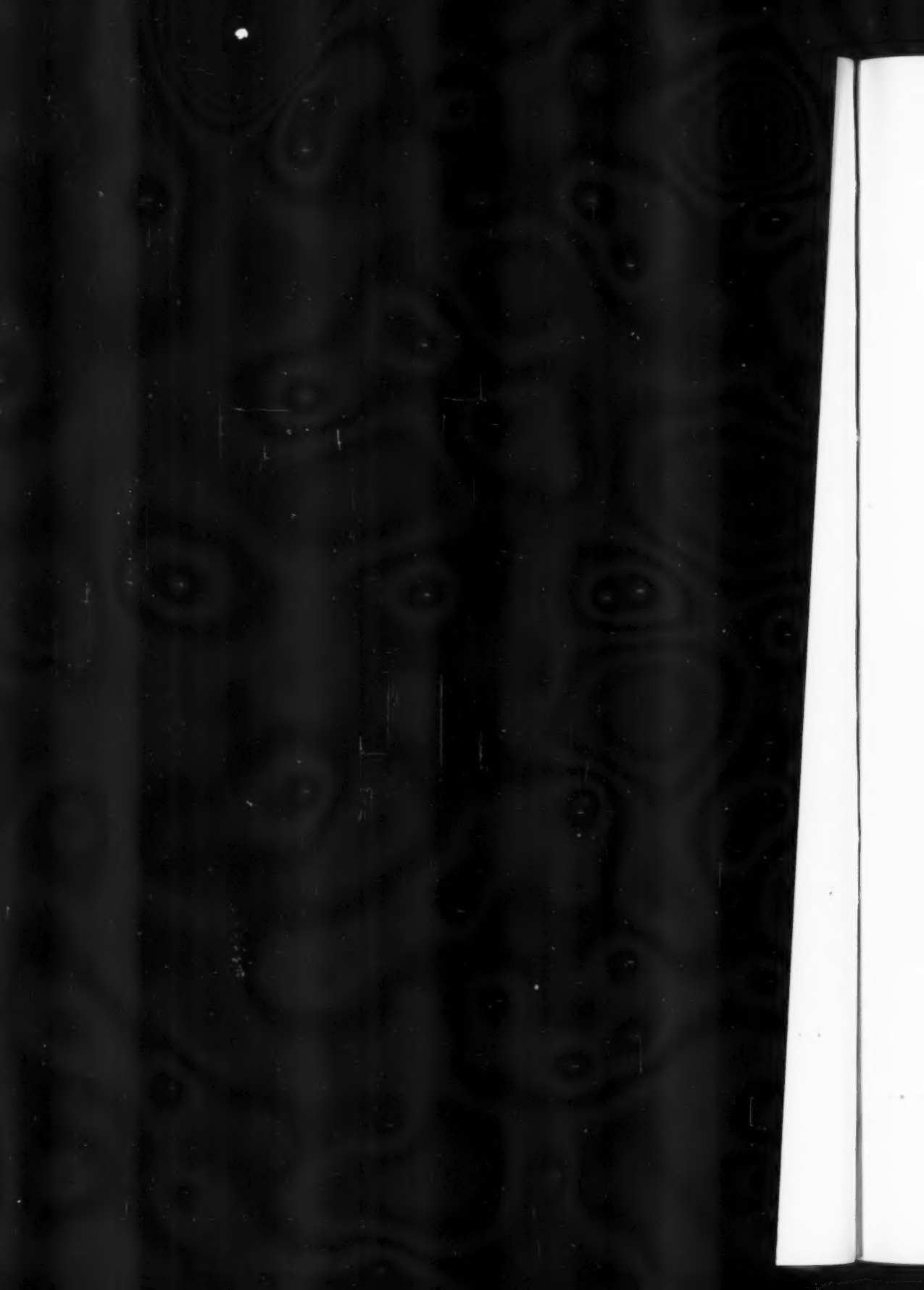

Fig. 10. Pancreas tumor.

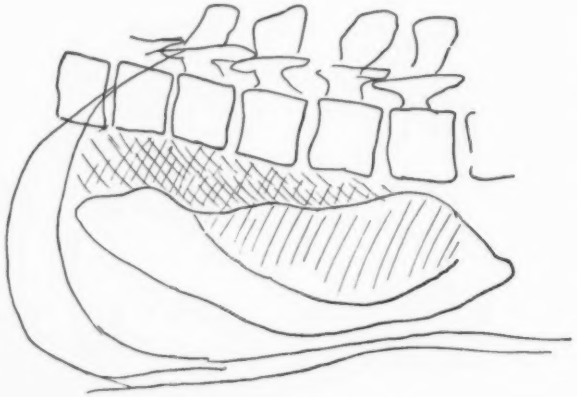

Fig. 11. Drawing to Fig. 10.

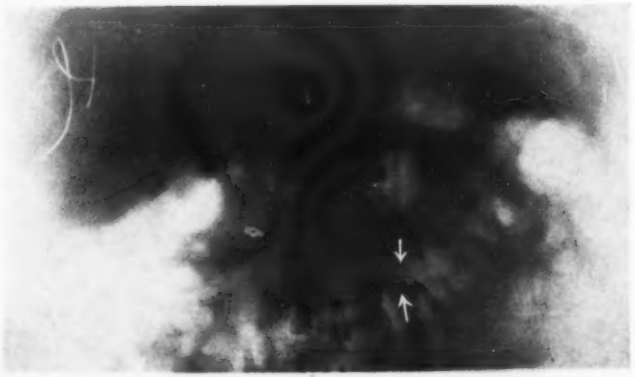

Fig. 12. Pancreatic calcification. Frontal view.

W.C.H.

Fig. 1

Fig. 13. Pancreatic calcifications. Side view.

Fig. 14. Pancreatic calcifications. Frontal view.

Fig. 15. Pancreatic calcifications. Side view.

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There was considerable icterus and liver enlargement, which symptoms subsequently, in addition to increasing cachexia, dominated the clinical picture until death supervened on Jan. 29, 1933. No appreciable pains.

Roentgen report Jan. 27, 1933. After inflation of the stomach not only does its posterior wall stand out clearly but a rounded soft-part shadow is also seen to depress the posterior wall into the gas-filled stomach. The distance from the spine to the top of this shadow amounts to about the breadth of two vertebral bodies.

Autopsy showed the pancreas somewhat enlarged, especially thicker than normal. It was hard and nodular. The cut section was tendinous, yellow-white. In the tail of the pancreas there were cavitations, the size of grains. Pancreas was intimately adherent to surrounding fat and connective tissue.

The last portion of the choledochus was completely obstructed. All the biliary ducts contained bile clear as water. Liver considerably enlarged. The whole parenchyma pervaded by yellow-white nodules of up to the size of walnuts.

Case 6. S., K., aged 70, magistrate. Surg. Clin. 2384/1933.

Diagnosis. Cancer of the pancreas (caput). Icterus gravis. Postoperative uraemia.

Earlier always in good health. Loss of appetite for the past two months. Has lost some weight. Four weeks ago icterus was observed. Since then this symptom has remained very much the same. Has not had any ache or pains in the abdomen.

Condition Sept. 3, 1933. General condition good, powerfully built man, but fairly stout. Icterus considerable with a tinge of green.

Abdomen. Large and fat. Liver edge is felt 3—4 finger-breadths below costal margin, is smooth but with a rounded border. No tenderness. *Urine:* dark, markedly icteric, bilirubin +, urobilin +. *Faeces:* grey-white. Urobilin faintly positive.

Roentgen report Sept. 6. Stomach of normal size and shape. Everywhere soft and even outlines. Normal folding of the mucous membrane. The duodenal bulb fills up without deformity.

After inflation of the stomach a large soft-part tumour can be seen at the site of the pancreas bulging into the dorsal part of the stomach. The growth certainly originating from the pancreatic region (tabula I fig. 5).

Sept. 11. Operation (SÖDERLUND). *Cholecysto-gastrostomy.* Oblique incision below the right costal margin. Gall-bladder and common bileduct under fairly well-marked tension. The head of the pancreas felt to be nodular and thickened (cancer). Cholecystogastrostomy was performed. Liver enlarged with a greenish discoloration, slightly cirrhotic.

Sept. 15. In spite of plenty of fluids urinary quantities diminished daily and there was complete anuria. Died this morning.

Case 7. D., M. J., aged 68. Ersta Hospital 1368, 959/1932.

Diagnosis. Inoperable cancer of the pancreas (intermediary form).

Under treatment here in 1919 (Gastritis acida). Ever since then been having pains now and then in the abdomen of diffuse nature but mainly in the upper part and radiating into the back. Since November 4 pains have been more severe. Vomiting. Stools grey-white since September. Has not had any jaundice. Has lost more than 10 kilogram in weight since August. Temperature never higher than 37°.6. *Dec. 8.* Icterus. Gall-bladder clearly palpable. *Urine.* Bilirubin +, urobilin +++. *Dec. 12. Operation.* Incision in the midline according to RISSLER. Gall-bladder enormously dilated and under great tension, on exploration by needle a green dark bile was obtained. No adhesions. Wall somewhat thickened. An elongated stone, the size of a nut, was felt to be lying free in the bladder. Pancreatic head somewhat enlarged, hard as a tumour. No adjacent

glands. As some pathological change in the pancreas (tumour or pancreatitis) was suspected of causing the constriction of the choledochus and the dilatation of the gall-bladder with consequent icterus, a communication was made between the gall-bladder and the stomach and the stone from the former removed at the same time. Primary suture.

Roentgen report Jan. 23, 1933. After inflation of the stomach the outline of the major curvature of the pyloric canal corresponding to the left part of the head of the pancreas is seen to be displaced upwards and ventrally and the horizontal inferior portion of the duodenum to be flattened out.

Death took place Sept. 16, 1933.

Case 8. S., J. A., born 1895, labourer. Med. Clinic I. 1299/1933.

Diagnosis. Cancer of the pancreas (intermediary form).

In February 1933 was taken ill with pains. In August icterus. In September cholecysto-duodenostomy at the Östersund Hospital. At the operation the liver was found to be enlarged (biliary stasis) and in the pancreas a cancerous growth, the size of twice that of a fist, was observed.

Med. Clinic I Dec. 6, 1933—May 5, 1934. *Diagnosis.* Cancer of the pancreas. *Abdomen.* Large hard tumour palpable to the right in the epigastrium.

Roentgen report Dec. 18. On inflation of the stomach there is seen at the site of the pancreas a somewhat irregular but mainly rounded soft-part tumour which has caused a depression into the posterior wall of the stomach (tabula XC, fig. 6).

Exploratory excision of Virchow's gland proved it to be cancer. Discharged home at his own request.

Case 9. P., P. J., aged 52. Ersta Hospital 1291, 905/1932.

Diagnosis. Cancer of the pancreas (cauda).

For 3 weeks been having aching pains in the right upper part of the abdomen radiating into the back; continuously gnawing pains and now and then pains coming on in attacks. Has vomited once in relation to the pains. — Never any jaundice.

Nov. 21. No tumour to be felt in the abdomen.

Roentgen report Nov. 24. Oral cholecystography normal.

Roentgen report Dec. 5. Stomach of ordinary size. The minor curvature of the vertical part of the stomach is somewhat shortened and seems to present a somewhat stiffer outline best noticeable in the erect position. The mucous membrane relief is fairly broad. Within the upper part of the vertical portion where the fornix begins there is observed an irregularity in the outline as well as in the mucous membrane configuration; the folds, however, are not interrupted. There is no obvious peristalsis in the minor curvature but well so in the major curvature. No typical defect can be detected. No change in the duodenal cap. After 4 hours there is a small residue in the vertical part of the stomach.

Although there are no absolutely certain clues for any pathological changes, the pictures do not, however, accord with the normal. New growth is what first comes to one's mind (HANSSON).

Dec. 20. Operation. No free fluid in the abdomen. Behind the stomach there is a firm nodular growth, at least the size of a goose-egg, at the site of the pancreas. It also seems to be adherent to the posterior wall of the stomach. Glands in the neighbourhood and upwards towards the aorta. *Diagnosis.* Cancer of the tail of the pancreas. Impossible to remove. Stomach of normal size. Major and minor curvatures free but it appears as if the tumour had caused infiltration of the posterior wall of the stomach. Primary closure.

Roentgen report Jan. 23, 1933. On inflation of the stomach a large soft-part growth is seen on the dorsal aspect of the corpus part of the stomach bulging its dorsal wall in an arc ventrally. The lower outline of the fornix shows a number of depressions of smaller size, clearly corresponding to the infiltration of the stomach wall (tabula XC, fig. 7).

Case 10. P., K. A., born 1896, farmer. Med. Clinic I 724/1933.

Diagnosis. Cancer of the pancreas (corpus).

In Dec. 1932 gnawing pains in the epigastrium. In March 1933 a tumour could be felt in the epigastrium. Admitted to the surgical clinic April 1. On admission mild jaundice. *Roentgen report March 8, 1933.* Stomach large and wide. In reclining position a depression is seen into the pyloric canal and on inflation of the stomach an arc-shaped depression is seen to appear into the dorsal wall of the pyloric canal. No changes can be observed in the mucous membrane relief of the stomach. No picture could be obtained showing the filling of the duodenal bulb, possibly owing to compression of it. The transverse colon takes its course in a wide curve on the caudal aspect of the tumour. No calcifications are observed within the region of the tumour.

Strikingly large shadow of the spleen, measuring about 8 × 18 cm.

The roentgen examination is indicative of a retroperitoneal growth, probably located in the pancreas.

March 11. On inflation of the stomach and the colon the tumour is demarcated upwards by the pyloric canal, which is elevated and displaced against the anterior abdominal wall, and cuadally by the depressed transverse colon.

The examination is thus showing an expansive process originating from the region of the pancreas, whether of cystic nature cannot be ascertained.

April 5. Explorative laparotomy. Large solid nodular tumour. It seems to arise from the body of the pancreas. Numerous indurated glands in the surroundings, one of which was removed. *Histological diagnosis.* Adenocarcinoma. Roentgen treatment.

Case 11. E., K. E., born 1886, scavenger. Med. Clin. I. 131/1933.

Diagnosis. Cancer of the pancreas (corpus), secondary anaemia, pernicious anaemia.

In 1929 patient was found to suffer from pernicious anaemia. Responded well to liver treatment and felt quite well during the next few years. In the latter half of 1932 fatigue, dizziness, cardiac palpitation and emaciation.

Admitted on Jan. 5, 1933 to the clinic. Was then running a subfebrile — slightly febrile temperature, had a high sedimentation test and moderate anaemia which more and more adopted a hypochromous character and on liver treatment proved refractory. While in hospital abdominal symptoms arose, vomiting, epigastric pains and a feeling of distension of the whole abdomen. Roentgen examination of stomach and colon was negative. On *March 8* a tumour could be felt to the left in the epigastrium. No jaundice.

Roentgen report March 8 and 10, 1933. After inflation of the stomach lateral skiagrams show tumours bulging into the stomach from behind as well as infiltration of that organ, extending on its posterior surface high up on the minor side (tabula XC, fig. 8). Skiagrams taken with an opaque medium show considerable displacement of the stomach sideways as well as irregular defects in it, bulging into the organ.

The roentgen examination shows infiltration of the stomach wall and large tumour formations in the lesser omentum.

Autopsy confirmed the presence of cancer of the pancreas originating from the body; pancreas enlarged and closely adherent to the stomach. Polypous tumorous masses had nvaded the stomach wall, bulging into its lumen.

Case 12. S., L., born 1868, a merchant. Södertälje. County Hospital 1932 and 1933.

Diagnosis. Cancer of the pancreas (corpus).

The patient was admitted on Oct. 10, 1932 on account of pains on the left side below the costal arch. These pains have lasted for about a fortnight.

Condition on adm. General condition good. *Abdomen.* Soft and not tender. No palpable tumours. *Testmeal:* achylia. Oct. 18: patient is feeling just the same. Now and then he suffers pains in the left part of the abdomen and epigastrium.

Nov. 4. Roentgen examination. Inflation of the stomach by Co 2 shows a large soft-part shadow situated in the pancreas region (pancreas tumour) (see tabula XC, fig. 9).

Nov. 10. Operation (NORMANN). (Laparotomy) incision in the midline. The mesenteric root is the seat of a diffusely growing tumour, the size of about a fist, which has originated from the pancreas or the posterior abdominal wall and is spreading out with string-shaped formations into the mesentery. Kidneys found normal on palpation. The growth being inoperable the abdomen was closed.

Jan. 11. Abdomen. Distinct tumour in the middle of the abdomen. Emaciation marked. Icterus. — *Feb. 1.* Death. *Patho-anat. diagn.* (Portion of pancreatic tumour.) Small-cellular cancer, rich in connective tissue, the cells forming mucus.

Case 13. B., A., born 1874, married, female. Cancer of the pancreas (caput). Referred to the Seraphimer Hospital by a practising colleague in Stockholm for roentgen examination. This practitioner had felt a tumorous swelling in the abdomen and considered it a case of cancer of the stomach.

Roentgen report Oct. 24, 1933 (barium meal). Stomach of normal size and with ordinary mucous membrane relief. No changes in the duodenal cap. After inflation of the stomach a large soft-part shadow, measuring at least 14 cm. in length, is observed at the site of the pancreas. It reaches to about $6^1/_2$ cm. in front of the anterior contour of the spinal column (tabula XCI, fig. 10, 11).

The patient died in Linköping on May 23, 1934. The following is the *post-mortem report* issued by Dr. ARVEDSON:

Much emaciated icteric body. The *stomach* shows no signs of ulceration or growth. *Gall-bladder*, at least the size of a goose-egg, distended with a dark thick bile. The *common bile-duct* is first much dilated, thick as a fore-finger, but just before reaching the duodenum it is surrounded by the growth in the head of the pancreas, which makes it impossible to trace its further course. *Pancreas.* Head transformed into a solid nodular growth, the size of a fist. Other parts of the pancreas are of ordinary appearance with a flaccid and limp consistence.

Cases of Pancreatitis

Roentgenological indirect signs of acute pancreatitis have been submitted by a number of authors in Sweden, among others by LINDBLOM (4) and HULTÉN (5).

The possibility of successfully employing our method of examination in cases of acute pancreatitis naturally depends entirely upon to what extent the pancreas is enlarged in such conditions. The operative findings in acute pancreatitis, whether it is a question of a primarily inflam-

matory process or an acute necrosis of the pancreas, includes swelling as a constant feature (compare conditions in inflammations of the anatomically fairly similar parotid gland and ELLMAN's (6) clinical study of 37 cases of acute interstitial pancreatitis showing oedema, swelling and induration of the pancreas but without necrosis, haemorrhage or suppuration). It would not seem improbable therefore that the method might yield information of diagnostic value in cases of acute pancreatitis. Unfortunately we have only had the opportunity of testing the method in one single case and that when the most acute stage had already passed. No enlargement of the gland could then be noticed. (For particulars see case 14.)

Nor were we able to demonstrate any enlargement in a case of relapsing pancreatitis with definite disturbance of the external secretion (case 16), just as little as in a case of well-marked hypochylia of the pancreas without any history of attacks or manifest inflammatory symptoms (case 15).

Even if chronic pancreatitis with tumorous enlargements of the organs have been described (Riedel tumours), such enlargements would not seem to be of frequent occurrence, and any greater number of cases with roentgenological enlargement of the pancreas can scarcely therefore be expected.

However, we have seen a case (case 17) with the probable diagnosis of subacute pancreatitis where the pancreatic enlargement, fully obvious at the height of the disease (checked at a week's interval), had undergone considerable reduction when the patient in perfect health twelve months later came for after-examination.

In cases such as nos. 15 and 16 one would perhaps in the first place expect atrophy of the organ. Neither in this case nor in 2 diabetic cases examined have we been able to demonstrate any reduction in size of the pancreas. Naturally to produce any roentgenological evidence such reduction in the volume of the pancreas must have reached a certain magnitude. From what we have observed, however, in for example case 5, this need not be very great.

In a few cases belonging to this group we were able to show pancreatic concretions (calcified healed foci after acute affections?) and it then struck us what great advantages the method would offer for the correct localisation of abdominal concretions to the pancreas.

Among the small number of 4 cases of acute and chronic pancreatitis we were thus unable to find any roentgenological changes in the volume of the pancreas in more than one case. On the other hand, for the discovery and localisation of pancreatic concretions the method has proved very useful.

Case 14. L., G. A., born 1886, engineer.

Diagnosis. Chronic and acute pancreatitis (pancreatic concretions).

For a week in March 1933 patient was ill in the same way as now; was then under treatment in hospital under the diagnosis of acute pancreatitis. Since then free from symptoms until now. Has not been yellow.

On Dec. 24 at 10 o'clock in the morning patient was taken ill with diarrhoea. After a couple of hours vomiting set in with aching pains in the middle of the abdomen. The ache was persistent, increasing more and more in intensity and was confined to the umbilical plane. In the evening he again vomited once or twice and had a rigor. No flatus.

In 1910 had lues (under treatment till 1917).

Condition on adm. General condition impaired. Temp. 40°. Pulse 84. Complains of ache in the middle of the abdomen. No icterus.

Abdomen. Perfectly soft, slightly distended. Fairly marked tenderness over an area, the size of the palm, to the left of the umbilicus. No tenderness over the gall-bladder region.

Roentgen report Dec. 30, 1933. In a general view of the abdomen there are seen on the level with the intervertebral disc between D. 12 and L. 1 some irregular calcifications the size of up to at least that of peas, located immediately to the left of and in front of the spine (pancreatic concretions) tabula XCI—XCII, fig. 12, 13.

After 3 days of contrast medication there is evidence of a very thin opaque filling of the gall-bladder. The opaque filling is too thin to permit of any concretions being, distinguished within.

Jan. 3, 1934. Operation (SÖDERLUND). Cholecysto-gastrostomy. Oblique incision below the right costal arch. Gall-bladder intensively distended, almost round as a ball but with thin walls. This was first emptied of about 100 cc. clear but somewhat dark and concentrated bile. A typical cholecysto-gastrostomy was then carried out. The entire pancreas was enlarged, particularly the body and tail. No local change in the pancreas could be felt. *Cultivation.* No culture obtained from the bile.

Jan. 27. Post-operative course favourable with normal progress of healing. Only occasionally milder pains of the same type as before the operation. *Feb. 5.* Free from abdominal symptoms. Discharged.

Commentary. It seems to us most probable that here as in case 16 the calcified foci are to be regarded as calcified necrotic areas in the gland rather than free concretions in the ducts. This view is supported by their size specially in referrence to their position within the gland.

Case 15. D., A. F., born 1871, iron turner. Med. Clin. I. 527/1934.

History of »gall-stone» attacks 9 years earlier.

About June 1, 1933 the patient found his skin getting mildly yellow and that his stools were copious with 2—3 evacuations daily. Beyond this no symptoms. Since then stools have been as before. Since onset of illness has lost about 20 kilogram in weight.

Has been troubled last days by an oily sort of mass, solidifying in the air, oozing out from the anus.

Condition May 4, 1934. Excessively emaciated. No fever. *Abdomen:* thin coverings, neither *liver, spleen, kidneys* or any tumorous swellings can be felt.

The stools per 24 hours amount to 250—400 grm. They are of an ointmentlike consistence with a clay-coloured appearance and contain masses of neutral fats and striped muscle fibres.

Ewald's test-meal. Achylia.

Duodenal probing. Fully normal conditions with a very dark-coloured bile from the gall-bladder after $MgSO_4$-injection.

Oral cholecystography. After 2 days' contrast medication a thin filling of the gall-bladder was obtained. No definite filling defects observed.

Diastase in the urine: 4.

Glucose tolerance test: low prolonged curve.

Roentgen report July 24. After inflation of the stomach with ca bon dioxide there was no increase of the distance between the stomach and the spine. Negative roentgen findings.

Roentgen report May 5, 1934. Distance between stomach and spine barely the breadth of a vertebra (on previous examination about that of a vertebral body).

The functional disturbances dominate in this case (achylia of the pancreas). Inflammatory symptoms are completely lacking. The reduced shadow of the pancreas is not significant.

Case 16. P., Hj., born 1881, county council school teacher. Med. Clin. 184, 988/1933.

Diagnosis. Pancreatitis chron. recidivans.

Since 1930 been having attacks of sudden onset of severe girdle-shaped abdominal pains. On one occasion there was no doubt about the presence of jaundice. The attacks generally terminate fairly quickly and accumulate in periods of 1—2 weeks. During these periods anorexia is well-marked. Stools semi-solid and light in colour, one or twice daily.

In July 1932 a severe period of pains began, followed by the loss of 25 kg. in weight during the following autumn.

Admitted the first time on Jan. 5, 1933. Great emaciation. No icterus. Loose to semi-solid grey-brown stools 2—3 times daily containing striped musculature, neutral fat and fatty acid crystals in glacic acid preparations.

Oral cholecystography. Bad filling of the gall-bladder.

Roentgen ex. Descending duodenum much dilated with mucous membrane folds strikingly high. Also in other parts of the small intestine the mucous membrane folding is irregular and coarse.

On this occasion a few calcified foci were observed in the upper part of the abdomen which were regarded as calcified glands.

The patient was readmitted on Sept. 18, 1933 for abscess of the prostata. While at home he had had no diarrhoea, nor any raised temperature and had increased in weight. (He had all the time been taking pancreatic tablets and been reducing fats and meat in his food.) After a test-meal of 100 grm. butter and 150 grm. raw meat he passed typical pancreatic stools of potty consistence and of almost claygrey colour with plenty of muscle fibres and fat. There were still therefore clear signs of pancreatic insufficiency.

Roentgen ex. of the pancreatic region with inflated stomach showed that the previously observed calcifications were situated at the site of the pancreas; this organ itself, however, did not seem to be enlarged (tabula XCII, fig. 14 and 15).

It seems to us most likely that these concretions are made up of calcified inflammatory foci or necrotic foci from the patient's earlier attacks.

No established disturbance of the function of the insular apparatus, nor any diastasuria.

Case 17. T., A. V., born 1882, laundry foreman. Med. Clin. I, 245/1933.

Diagnosis. Subacute pancreatitis.

About 1912 had gall-stone attacks with jaundice. Renal calculus in 1926. In 1927 abdominal pains, vomiting, jaundice and fever.

In the beginning of 1932 very tired. A little later gnawing pains set in and on several occasions mild icterus of brief duration without aggravated pains. Lost 14 kilogram in weight during the last two months. For the same length of time had diarrhoea during periods of a couple of days.

Condition on adm. (abstract) Feb. 15, 1933. Afebrile. No icterus. Liver palpable 2 finger-breaths below costal arch.

Two — three motions daily. Examinations of stools are few and incomplete. March 8 plenty of fatty acid needles in glacic acid preparations.

Feb. 20 Ewald's test-meal. Achylia.

March 4 Cholecystography. Gall-bladder sparingly filled up, with soft regular outlines and showing no defects in the contrast. Gall-bladder empties well after meals.

Roentgen report March 4. Stomach of normal size with high folding of mucous membrane. Peristalsis is proceeding unhindered. No deformity in stomach or duodenal cap. — After inflation of stomach it is seen to be displaced forwards and the distance between it and the spine considerably increased; this is in favour of the body and tail of the pancreas being enlarged.

March 6: note of icterus having arisen and increased within the course of a fortnight.

March 13 roentgen report. After inflation of the stomach with carbon dioxide the distance between the pyloric canal and the posterior contour of the spine is seen to be greater than normal, indicating *enlargement of the pancreas.*

March 15: distase in urine 8.

Lost 7.8 kg in weight while in hospital and was discharged at his own request on March 20 with persistent mild jaundice. The diagnosis then made was ? cancer of the pancreas?

After-examination April 9, 1934. Gradual complete recovery. Motions daily, formed. Weight 80.8 kg., thus an increase of about 20 kg.

Abdomen. Small area of mild tenderness 2 finger-breadths to the right of the umbilicus. — Faeces: formed, loose, brown. No mucus. Weber negative. Plenty of muscle fibres moderate amount of iodophil bacteria and substance, sparing amount of neutral fat and fatty acid needles.

Roentgen examination. Distinct reduction in size of the pancreas since last examination.

Commentary. Although of course this case may only have been one of subacute hepatitis it s[illegible] to us, above all on account of the frequent motions with increased fatty contents [illegible] none or only mild jaundice, that some affection of the pancreas is exceedingly pro[illegible]le. The condition of the stools more than twelve months later also seem to point in that direction. Moreover the excessive emaciation also accords with the latter diagnosis.

It is exceedingly interesting in this case to follow the enlargement of the pancreas which after its maximum during the height of the illness on after-examination proved to have diminished very considerably. This circumstance, too, must be in favour of pancreatitis being the correct diagnosis.

SUMMARY

The authors submit here in somewhat closer detail their method of showing the pancreas on the radiogram by inflation of the stomach with CO_2.

The method has for the past 18 months been employed as the routine method at the Seraphimer Hospital, Stockholm, in the examination of suspicious cases of affections of the pancreas. The results obtained are submitted and discussed. The method seems to signify a decided advance in the diagnostics of pancreatic conditions.

ZUSAMMENFASSUNG

Die Verfasser legen hier in etwas näherem Detail ihre Methode vor, mit der sie das Pankreas durch Aufblasung des Magens mit CO_2 auf dem Radiogramm sichtbar machen.

Die Methode wurde am Seraphimerkrankenhause, Stockholm, in den letzten 18 Monaten als regelmässiges Verfahren bei der täglichen Arbeit zur Untersuchung bei Verdacht auf Pankreasaffektionen angewendet. Die erreichten Resultate werden von den Verfassern mitgeteilt und erörtert. Die Methode scheint einen entschiedenen Fortschritt in der Diagnostik pankreatischer Zustände zu bedeuten.

RÉSUMÉ

Les auteurs exposent ici avec des détails un peu plus précis leur méthode d'exploration du pancréas sur des radiogrammes par dilatation de l'estomac avec CO_2.

Cette méthode a été, depuis 18 mois systématiquement utilisée à l'Hôpital des Séraphins de Stockholm dans l'examen des cas douteux d'affection pancréatique. Les auteurs exposent et discutent les résultats atteints. La méthode semble impliquer un progrès manifeste dans le diagnostic de l'état du pancréas.

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FROM THE ROENTGEN DEPARTMENT OF THE ROYAL SERAPHIMER HOSPITAL, STOCKHOLM.
CHIEF: PROF. GÖSTA FORSSELL

THE ROENTGEN APPEARANCE IN FOUR CASES OF BASILAR IMPRESSION[1]

by

Bertil Ebenius

(Tabulæ XCIII—XCIV)

Basilar impression — or platybasia as it is less adequately termed — is a fairly rare phenomenon. Only a few cases are found described in the literature although the condition has been known for a long time. ROKITANSKY gave mention to it as early as 1844 but VIRCHOW was the first to submit a more detailed description of the skull deformity in question. The roentgen appearance has been described by SCHÜLLER.

The anatomical changes are dominated by the impressed posterior fossa of the skull. Foramen magnum is displaced upwards and its margins are in well-marked cases directed upwards. Clivus is deformed and much less tilted. The floor of the posterior fossa of the skull is generally very thin. In young subjects signs of hydrocephalus are occasionally present and may be primary. Whether the narrowing of the posterior fossa of the skull and the thereby increased intracranial pressure may secondarily produce a hydrocephalic shape of the skull is rather uncertain. Occasionally changes in the cervical spine occur in cases of basilar impression. Atlas may be thinned out and defective and may be fused, entirely or in part, with the base of the skull. Deformity of the axis and fusion of the vertebral bodies of the upper cervical region may also occur, so that the roentgen appearance may resemble that present in KLIPPEL-FEIL's syndrome. From without the neck appears in more pronounced cases to be strikingly short. As in addition the head is kept bent slightly backwards, the patients get a characteristic appearance which may be a guide to the diagnosis.

Regarding the etiology many suggestions have been made. So has rickets been put forward as one of the commoner causes. Attenuation

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of the base of the skull in hydrocephalus is also said to give rise to depression of the region around the foramen magnum. Similar deformity of the base of the skull has been met with in ostitis deformans and dystrophia cleido-cranialis as also in puerperal and senile osteomalacia. In some cases one has been unable to find any etiological factor at all. Such cases may perhaps be referred to a genuine form of basilar depression in contradistinction to those arising secondarily. The condition has to be regarded in the first place as a deformity arisen as a result of an abnormally pliable base of the skull, unable to bear the weight.

The symptoms from the nervous system are occasioned by the reduced volume of the posterior fossa of the skull and the abnormal pressure conditions arising therefrom. These symptoms may be of the following kinds:

1) Symptoms of cerebellar disturbances.

2) Symptoms from the medulla oblongata by its compression by the odontoid process.

3) Symptoms of irritation and paralysis of the cerebral nerves in the posterior fossa of the skull and the uppermost spinal nerves.

4) Generalized increase of the intracranial pressure.

In general the disease takes a typically chronic course with slowly progressive symptoms. It may arise in children as well as adults. The only treatment that may be considered is decompressive trepanation but not even with this can any great improvement be expected. The prognosis is thus bad, at least in the more advanced cases. Acute compression of the cerebellum may suddenly cause the patient's death.

The roentgen appearance in cases of basilar impression accords with the anatomical changes. The deformity of the posterior fossa of the skull is best seen in lateral and frontal-dorsal projection. In the latter case the pictures are taken with the patient in the supine position and the film against the neck, the central ray being parallel with the sagittal plane of the head and the tube inclined 35° cranially from the vertical zero-position. By the fact that the posterior part of the clivus is pressed up, the basal angle is increased even up to 180°. Generally the roentgen examination settles the diagnosis.

At the Seraphimer Hospital we have had in the course of the four last years four cases of basilar impression with typical roentgenological changes. In what follows I shall describe the roentgenological signs and at the same time give some of the more important data from the case records which have kindly been placed at my disposal by Professor N. Antoni (neurological clinic) and Dr. H. Olivecrona (neuro-surgical clinic).

Case I. I. E., aged 15.

Rickets in the childhood. Progressive symptoms from the nervous system for $2^1/_2$ years consisting of headache, localized to the neck, weakness in lower limbs and disturbed equilibrium. In January 1931 admitted to the nerve clinic of the hospital presenting the following symptoms and signs: square head of hydrocephalic size (circumference of skull 64 cm.). Vision reduced. Choked discs. Nystagmus. ROMBERG positive. Spastic atactic gait. In April 1931 transferred to the neuro-surgical clinic where operation was performed: explorative exposure of lamina quadrigemina and posterior part of the third ventricle. — The diagnosis had not been settled at the time of operation. The depression of the base of the skull had not been observed at the roentgen examination. Four weeks after the operation patient died from compression of the cerebellum. On autopsy was found well-marked basilar impression with pronounced deformity of the cerebellum and medulla oblongata.

Radiograms show the following skull changes (fig. 1 and 2). — Long hydrocephalic vault with separated sutures. Posterior fossa much elongated and its floor forcibly elevated around the widened foramen magnum, the margins of which are directed upwards. Basal angle increased. Atlas and axis deformed.

Case II. E. A., aged 21.

As a child probably rickets. The head has always been of elongated shape and the forehead broad. Impaired vision for the last three years. For the past twelve months hedache localized to the top of the head. Mild disturbance of equilibrium. — In September 1932 transferred to the neuro-surgical clinic presenting, among others, the following symptoms: choked discs, nystagmus. Gait somewhat uncertain. ROMBERG negative. *Operation:* suboccipital decompression through bilateral exposure of the cerebellum. — Some improvement after operation.

In this as also in the following cases the diagnosis was made through the roentgen examination.

Roentgenological findings (fig. 3 and 4): Elongated vault with signs of increased intracranial pressure. Posterior fossa of skull flattened out and its floor markedly attenuated. Typical basilar depression with increased basal angle. The two uppermost cervical vertebrae deformed.

Case III. M. B., aged 59.

Since 6 years double vision and disturbance of equilibrium. For the last 3 years difficulties in swallowing. Headache. In September 1933 admitted to the nerve clinic of the hospital with symptoms as follows: Short neck. A slight ptosis of one eye. Strabismus convergent. Unilateral paresis of the pharynx. Nystagmus. ROMBERG positive. Gait unsteady. No oedema of discs. In november 1933 operated at the neuro-surgical clinic. Suboccipital decompression was performed. Only slight subjective improvement has been observed after operation.

Roentgenexamination: (fig. 5 and 6). The attenuated floor in the posterior fossa of the skull is forcibly elevated around the foramen magnum. Atlas and the odontoid process are in a level with the pyramids (fig. 6) Basal angle increased. Dilated grooves for the vessels within the vault. The two uppermost cervical vertebrae slightly deformed.

Case IV. E. H., aged 46.

Disturbance of equilibrium for the past 2 years. Later also giddiness and double vision. Feeling of weight and pressure in the neck. On admission to the nerve clinic in September 1933 the patient presented, among others, the following symptoms: nystagmus,

Fig. 1.

Fig. 2.

Fig. 3.

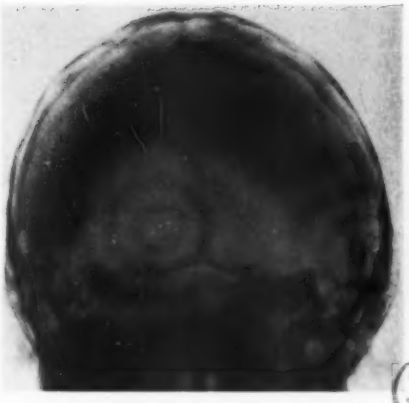

Fig. 4.

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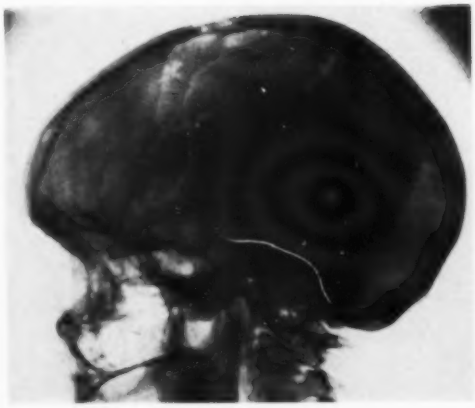

Fig. 5.

Fig. 6.

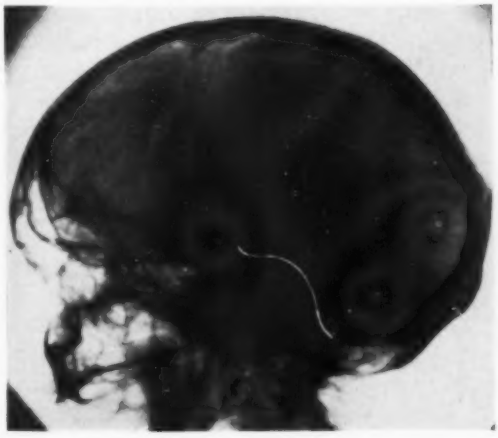

Fig. 7.

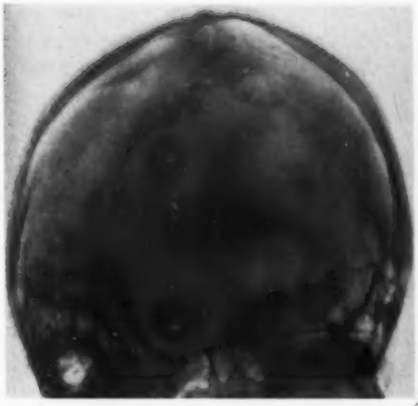

Fig. 8.

positive ROMBERG. Gait unsteady. No oedema of discs. At the neuro-surgical clinic suboccipital decompression was subsequently carried out with resection of the arch of the atlas. For a short time after the operation there was mild paresis of the pharynx. Subjective improvement followed.

Roentgenological findings (fig. 7 and 8). — The floor of the posterior fossa markedly attenuated but the vault otherwise of ordinary thickness. Typical basilar impression with deformity of clivus and the uppermost cervical vertebrae. Slightly increased vascularity of the vault.

Ventriculography with air and lipiodol (while in the neurological clinic). — No dilatation of either lateral or third ventricles. Aquaeductus Sylvii prolonged and displaced in an arch-shaped manner, upward-backwards. The fourth ventricle is partly located below the foramen magnum. It is deformed but not dilated. Fig. 9 shows the shape of the ventricles and that of the base of the skull. For the sake of comparison the picture shows also a normal ventriculogram (dotted lines).

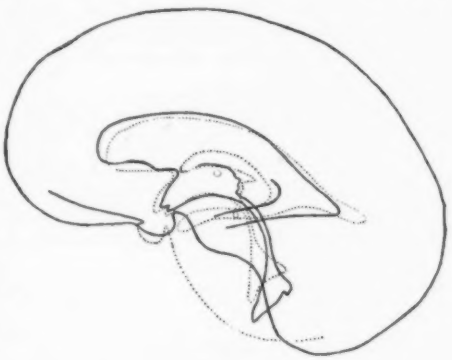

Fig. 9.

These 4 cases well illustrate the roentgenological changes present in basilar impression. In all of them there was typical deformity of the posterior fossa of the skull. In certain respects, however, the two former cases differ from the two latter, the former being young subjects with roentgenological signs of hydrocephalus. In reference to what has been mentioned above regarding the etiology it would have been of interest to show, had one been able to, the relation between the hydrocephalus and the basilar impression; neither the roentgen examination nor the clinical picture allowed, however, any definite conclusions being drawn in this direction. Nor could it be proved that rickets in early life had been the cause of the depression of the base of the skull.

In the two latter cases it was a question of older patients (46 and 59 years). There was no hydrocephalus here but dilated grooves for the vessels as a sign of hindered outflow for the veins of the vault. In neither of these two cases could one find any senile atrophy or other cause of the basilar depression.

By the cases related above we have wished to draw attention to the roentgenological appearance of basilar impression which, even if easily interpreted, may yet be readily misjudged, if one is unfamiliar with it — particularly so if other changes of the skull are simultaneously well marked.

SUMMARY

The basilar impression gives a typical roentgenologic picture. The base of the cranium around the foramen magnum is thinned and pressed inwards, the basilar angle increased. Even changes in the vault, and in the cervical spine, may occur. The roentgen examination is determining for the diagnosis.

ZUSAMMENFASSUNG

Die basilare Impression gibt ein typisches Röntgenbild. Die Schädelbasis ist um das Foramen magnum verdünnt und hinaufgedrückt. Der Basalwinkel ist vergrössert. Auch im Schädeldach und in der Halswirbelsäule kommen Veränderungen vor. Für die Diagnose ist die Röntgenuntersuchung ausschlaggebend.

RÉSUMÉ

L'impression basilaire donne une image radiologique typique. La base du crâne est, autour du trou grand rond, amincie et déviée vers le haut. L'angle basilaire est augmenté. On trouve également des lésions au niveau de la calotte et de la colonne cervicale. L'examen radiologique est décisif pour le diagnostic.

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FROM THE ROENTGEN DEPARTMENT OF THE SERAPHIMER HOSPITAL, STOCKHOLM.
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THE VOLUME OF THE HEART IN MÜLLER'S AND VALSALVA'S TESTS[1]

by

Petter Natvig

(Tabula XCV)

It is well known that the volume of the heart increases in MÜLLER's test (inspiration with closed glottis) and that it diminishes in VALSALVA's test (forced exspiration with closed glottis). MÜLLER's test is generally carried out in a position of exspiration and VALSALVA's test in a position of inspiration. The shape of the heart alters so much at the different positions of the diaphragm that the pictures cannot be directly compared.

In the personal experiments to be related below the exposures were made in a position of medium deep inspiration; in the antero-posterior pictures the dome of the diaphragm can be seen to stand practically at the same level, at the top of the 7th rib. The pictures were taken with the arms flexed over the head, the lateral pictures 1—2 seconds after the antero-posterior ones in the same phase of respiration.

In MÜLLER's test there is a considerable increase of the cardiac shadow The long diameter of the heart has increased from 15 in VALSALVA's test to 17.5 cm., the transverse diameter at right angles to the long diameter from 10 to 12.5 cm. The diameter in a sagittal direction has increased less, from 10 to 11 cm. Similarly, in MÜLLER's test, the vascular shadow above the heart is seen to have increased in breadth from 5.5 to 7 cm. and the hilum vessels show a much increased filling. — By modification of KAHLSTORF's computation method the heart can be regarded as an elipsoid, the volume of which is obtained by multiplying the three diameters with a factor varying with the focal distance. With a focal distance of 2 m. this factor is 0.44. The method is said to be reliable with an error that does not exceed 5 %, and when three diameters are measured the result is independent of the position of the diaphragm.

In MÜLLER's test the volume was found to be 1.050 cc, in VALSALVA's test 660 cc., the difference being thus 390 cc. My normal cardiac volume

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is calculated by the same method to 860 cc. and is thus midway between the volumes obtained in the two tests. The difference is great enough to exceed by a long way the sum of the errors. The greatest source of error is involved in the possibility of one of the exposures being made during systole and the other during diastole; this may yield a maximum difference of 100—150 cc. A less error is also caused by the difficulty of directing the beam in exactly the same way in corresponding exposures.

On screening examination it may be seen how the heart in MÜLLER's test rapidly dilates (in the course of 10 sec.) whereas in VALSALVA's test the reduction of volume takes a longer time, 30—40 seconds, for attaining a considerable reduction.

The tests show what a striking elasticity is possessed by the healthy heart, but as a method of examination in suspicious cardiac disease it can certainly not be recommended, since in such cases it would mean too much of a strain.

In ordinary roentgen photography of the heart, the time elapsed from the moment the patient is told to hold his breath and the exposure, is generally so short that the risk of any change in the volume on account of any exspiratory strain or inspiration with closed glottis need not be considered, the more so as it comes most natural for the patient to strain, and it takes a relatively long time for such a strain to bring about any change in the volume.

SUMMARY

Cardiograms are submitted taken of the same subject during MÜLLER's and VALSALVA's tests. The difference between the two cardiac volumes is 390 cc.

ZUSAMMENFASSUNG

Verf. legt Kardiogramme vor, die vom selben Individuum während der Müllerschen und Valsalvaschen Probe aufgenommen wurden. Der Unterschied zwischen den beiden Herzvolumina beträgt 390 ccm.

RÉSUMÉ

L'auteur communique des cardiogrammes pris chez le même sujet avec les tests de MÜLLER et de VALSALVA. La différence entre les deux volumes cardiaques était de 390 cc.

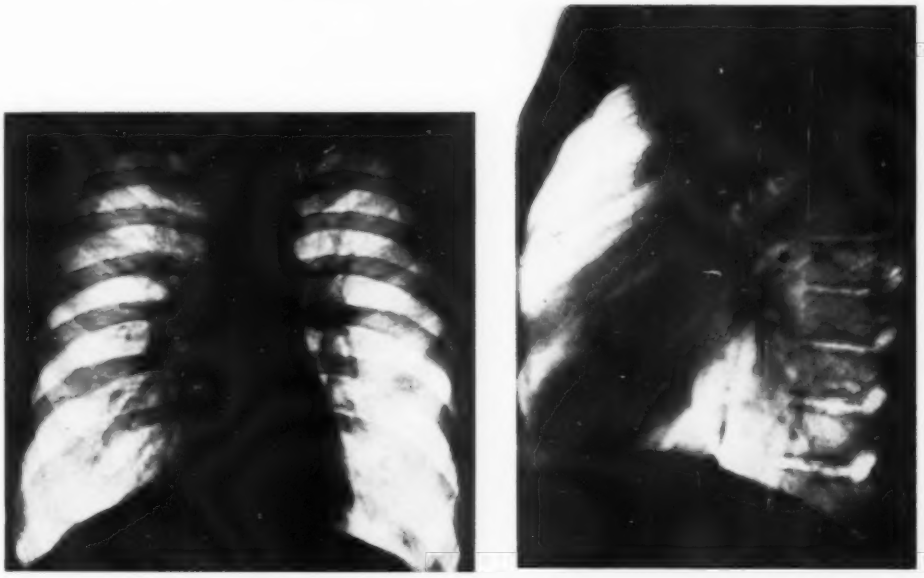

Fig. 1 and 2. VALSALVA's test.

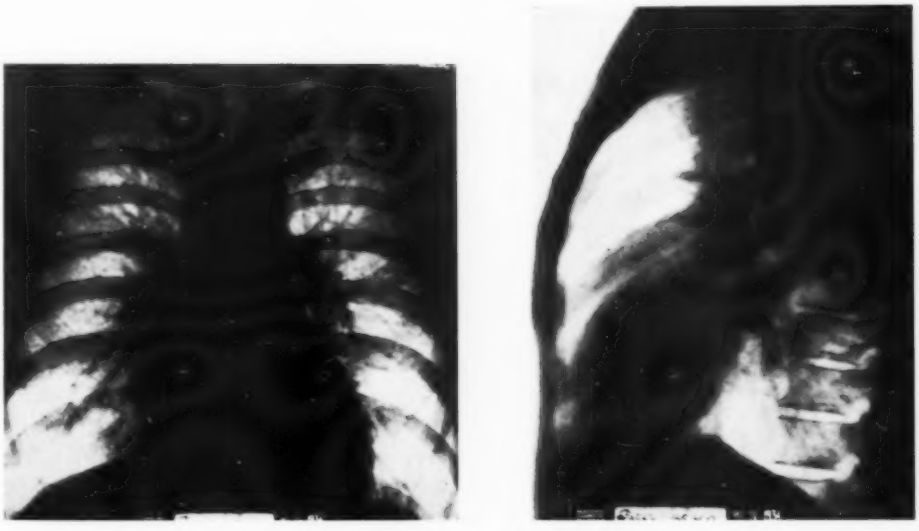

Fig. 3 and 4. MÜLLER's test.

FROM THE ROENTGEN DEPARTMENT OF THE ROYAL SERAPHIMER HOSPITAL, STOCKHOLM.
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ON THE LOCALIZATION OF CALCIFIED PINEAL BODIES UNDER NORMAL AND PATHOLOGICAL CONDITIONS[1]

by

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Involution of the epiphysis cerebri or corpus pineale commences in childhood. During this process calcification frequently occurs in the organ to such a considerable degree that it may be recognized by roentgen examination. A displacement of the pineal body beyond the limits for the normal variation may help us to establish the presence and estimate the location of expansive intracranial processes. In such case, however, it is necessary to have a thorough knowledge of the normal position of the pineal body and its variability and also to realize from individual observations the significance of such displacements.

As early as 1912 SCHÜLLER referred to the method of utilizing the position of the pineal body in the diagnosis of some intracranial affections. This author as also NAFFZIGER has referred only to displacement in a lateral direction. VASTINE and KINNEY and later DYKE, having at their disposal CUSHING's extensive material, have published papers regarding the position of the pineal body under normal and pathological conditions. They found displacements of the pineal body in cases of intracranial expansive processes to be of rather common occurrence. VASTINE as well as DYKE emphasized, however, that the method adopted by VASTINE and KINNEY is not always reliable; this has also been found to be the case by experience at the Roentgen Department of the Seraphimer Hospital. I shall not enter here upon any closer criticism of the method in question but will only emphasize that the limit between normal and pathological positions of the pineal body must absolutely be determined by some statistical method, where all the variable factors are taken into consideration. So far as I am aware no such calculation has previously been carried out. This question of the position of the pineal body under normal and pathological conditions therefore requires thorough investigation.

At the Roentgen Department of the Seraphimer Hospital I have had at my disposal sufficiently extensive material, normal as well as pathological, to permit of statistical conclusions being drawn.

[1] Submitted for publication May 28th, 1934.

It must be presumed here that the reader is familiar with fundamental statistical rules and the sources of error attending the roentgenological method with regard to distances measured on radiograms. Regarding the statistical method I will only call attention to some conceptions. If 2.5 times the standard deviation (σ)[1] is added to and subtracted from the arithmetic mean one observation out of 83 will fall outside the thus computed range of variation. If this is calculated with $\pm 3\ \sigma$ the corresponding figure will be 1 in 370. An observation falling outside $\pm 2.5\ \sigma$ reckoned from the mean is generally considered as *probably* due to special factors which do not belong to the series. If the observation in the same way also falls outside $\pm 3\ \sigma$, the case in question may be considered with *certainty* from statistical point of view as not belonging to the series.

In the roentgen examination of my cases the LYSHOLM special table for examination of the skull has been employed throughout. The advantage of this is obvious. It enables the positioning of the patient's head in the different cases to be carried out as uniformly as possible. The distance from the focus of the tube to the film (65 cm.) and from the surface of the table to the film (4 cm.) have in all cases been identical. For the examination of the position of the pineal body two projections only are needed; antero-posterior to ascertain the possible presence of a lateral displacement, and lateral to determine the position in the median sagittal plane. In taking the anteroposterior view the patient is in the supine position with the head so placed that the horizontal plane through the infraorbital margin and the external auditory meatus becomes vertical. The focus is centered right above the mouth and the tube is tilted 35 degrees cranially. The lateral picture is taken after placing the median sagittal plane as far as possible parallel with the film and with the focus centered a little above (about 2 cm.) and slightly in front of the external auditory meatus. When, as has been the rule, stereoscopical pictures are taken, the tube is tilted cranially in a somewhat different manner in the different cases, usually 6 and 10 degrees.

The normal material I have dealt with in the following manner. All skulls during a certain period of time presenting normal roentgen appearances have been subjected to examination. No skull has been excluded on account of any uncommon configuration. From this material all those skulls have been selected which on careful examination have shown that calcification of the pineal body can be considered as

[1] The standard deviation has been calculated after the formula $\sqrt{\frac{\Sigma a^2}{n}}$ where Σ is the summation sign, a the deviation from the arithmetic mean and n stands for the number of observations.

certain. From the material so obtained all those cases have been left out, where certain or suspicious brain tumour has been clinically diagnosed. Cases in which no diagnosis has been obtainable from documents available have also been excluded as also all cases below 20 years of age. In this way I have obtained a normal series of cases comprising 200 skulls for measurement and statistical calculation. In these cases, consequently, there are no signs of any organic changes whatever or, at any rate, none of tumour. In some case or other the possibility of some expansive process being nevertheless present must of course be reckoned with, and consequently the standard deviation of the measurements from the pineal body may be considered a little too great from a theoretical point of view. In practice, however, the occurrance of an odd case of this nature may be neglected.

The incidence of calcification of the pineal body in my normal material, comprising 769 skulls, amounts to 34 % and in ages above 20 years to 40 %. Since only sure cases have been accepted as positive a great number of more or less doubtful cases have been left out. Hence my figures undoubtedly show a minimum frequency.

How is then the normal position of the pineal body to be established?

On an antero-posterior radiogram of the skull the position of the median sagittal plane can usually be fairly exactly determined, and so it can also be established whether the pineal body, as usual, is located in this plane or not. It is much more difficult to determine the position of the pineal body on a lateral view. It seems most appropriate to find the measurements from the pineal body to the periphery of the skull in the above-mentioned sagittal plane. In the lateral projection points in this plane are easily available.

On the lateral radiogram I have selected several points in the median sagittal plane and then measured the distances from the pineal body to these points, the first located basally and the remainder on the inner table. The following are the points utilized (see diagram):

1. Sphenoidal. The point where the median sagittal plane cuts the anterior border of the sella turcica (tuberculum sellae).

2. The median point of the upper border of the glabella (the most prominent point of the lower part of the frontal bone above the root of the nose).

3. A median point on the skull half way between the glabella and bregma, as measured on the straight line between these points.

4. Bregma. The median point where the sagittal and coronal sutures meet.

5. Vertex. The highest point of the vault in the median sagittal plane, when the line from the infraorbital margin to the external auditory meatus is horizontal.

6. A median point on the vault half way between the bregma and lambda measured on the straight line between these points.

7. Lambda. The point where the sagittal suture meets the two limbs of the lambdoid suture.

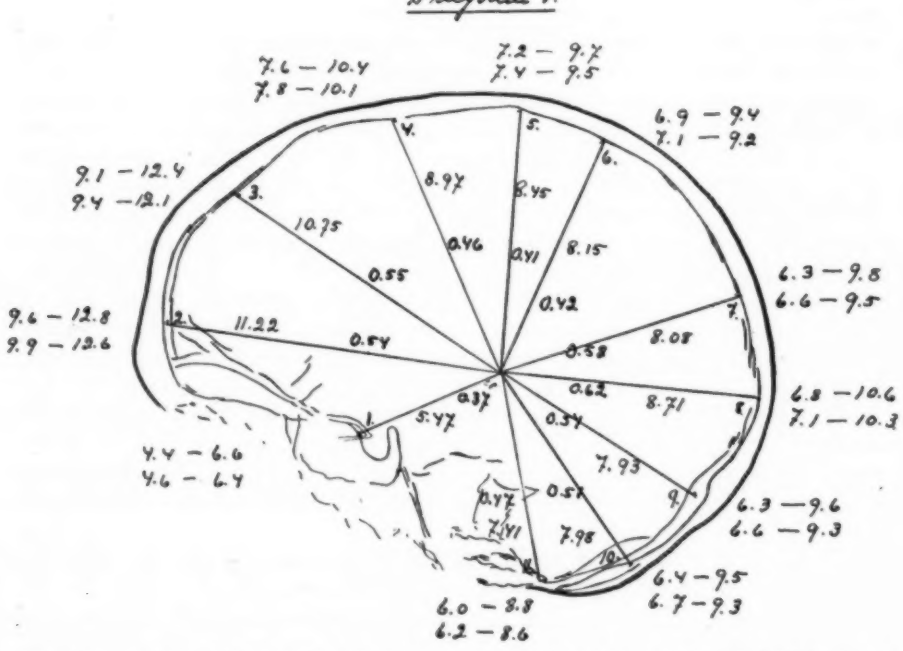
8. A median point corresponding to the deepest excavation of the occipital fossae.

9. A median point on the internal occipital protuberance.

10. A median point corresponding to the deepest excavation of the cerebellar fossae.

11. Opisthion. The point where the median sagittal plane meets the posterior circumference of the foramen magnum.

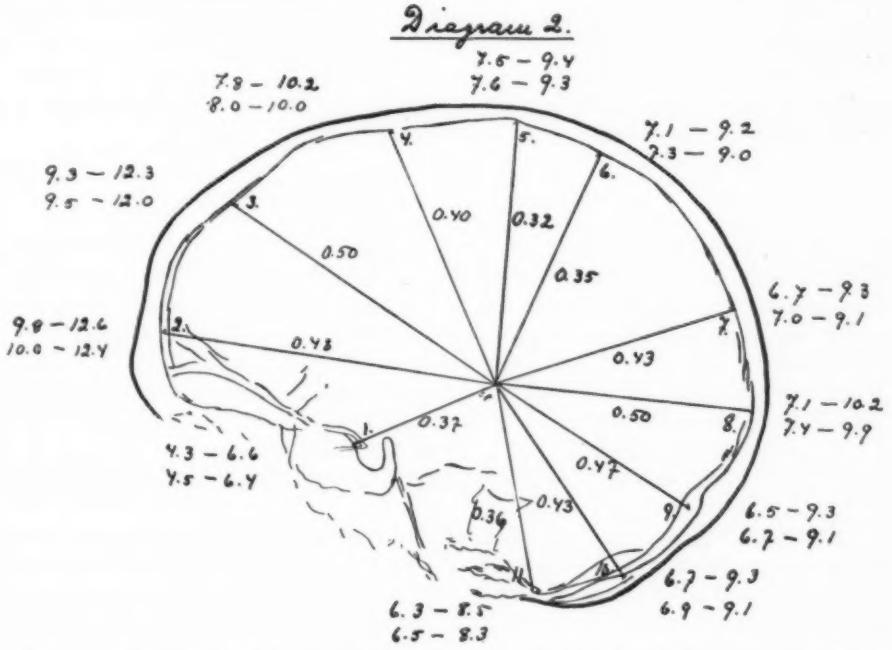
Diagram 1 shows the distances measured from the pineal body to the different points of the skull (ranges of variation, mean figure and standard deviation).



The figures around the skull indicate the ranges of variation calculated with $\pm$ 3 σ and $\pm$ 2.5 σ respectively. The figures within the periphery of the skull indicate the points already described. The figures within these indicate the mean figures, while the innermost figures show the standard deviation for the different measurements.

So far all the examined skulls have been dealt with in one single series, A. The material, however, has also been divided into two groups, one, series B, according to the length of the skull (glabella-lambda) and another, series C, according to its height (vertex-opisthion). By leaving out those skulls showing more extreme measurements an intermediate group has been obtained in each series and to this has been referred all those cases, where the measurements of length and height have been lying within $\pm 1\ \sigma$ reckoned from the mean.

Diagram 2 illustrates a fusion of series B and C. Measurements 1, 2, 7, 8, 9, which are mainly measures of length, have been obtained from series B, which was classified according to the length of the skull, while the other measurements, which are mainly measures of height, have been obtained from series C, where the height of the skull has been the basis of classification.[1]



The figures here have the same significance as in Diagram 1; the mean figures, however, have been excluded here since these naturally lie very near those given in Diagram 1.

[1] Still further restriction of the variability of the measurements would seem feasible by stating the distances from the pineal body in percentages of the length and height of the skull. The results of such a method of estimation will be submitted later.

If the length and height of the skull are within the mean $\pm 3\ \sigma$ i. e. between 16.3—21.4 and 13.7—17.7 cm. respectively, then the measurements stated in Diagram 1 are to be used as standard measurements. If the length and height of the skull are within the mean $\pm 1\ \sigma$, i. e. between 17.2—20.6 and 14.4—17.0 cm. respectively, Diagram 2 may also be used which gives a closer location of the pineal body after classification. If only the length of the skull is within the mean $\pm 1\ \sigma$, the measures of length in Diagram 2 can be used, whereas for the measures of height the reader is referred to Diagram 1, which comprises the whole series without classification. The same holds true mutatis mutandis for the height of the skull.

Of the ranges of variation appearing in the diagrams the upper figures have been computed from the mean with a safety margin of $\pm 3\ \sigma$ and the lower ones with a margin of $\pm 2.5\ \sigma$. If a measurement from the pineal body is found to be beyond the former range of variation it is therefore certain to be pathological; if outside the latter range it is probably pathological.

The figures stated here are thus the result of the statistical investigation of the position of the pineal body in normal cases and serve as a comparison when dealing with pathological cases.

* * *

Dr. H. Olivecrona has kindly placed at my disposal his extensive clinical material of verified brain tumours with precise data regarding localization, size and nature, etc. The roentgen examination of these cases has been carried out with the same method as in the normal material. Only such cases have been dealt with in whom the tumour has been verified through operation or autopsy. All cases for a certain period of time which showed a roentgenologically visible pineal body have been examined. This material comprises 60 cases.

In a considerable percentage of cases the pineal body had been displaced (see table 1.).

Tumours with similar localization were grouped together. It was then found that the position of the pineal body largely coincided in different cases within the same group, provided — and this is a necessary qualification — that the size of the tumour and also that of the skull in the individual case are taken into consideration. It is important to consider not only the measurements in one direction from the pineal body, but also the antagonistic measurements. If, therefore, e. g. the distances forwards from the pineal body are found to be too large, the measurements in the opposite direction must also be taken into consideration, before any displacement can be established.

The calculation on the pathological material has been made in the following manner.

The whole material was first dealt with without any classification. On further calculation it was divided into groups, the first basis of classification being the position of the tumour in relation to the tentorium cerebelli. The cases have also been classified according to the different parts of brain where the tumours have been located. The results will be evident from the following tables.

Table 1

	Cases with displacement of corpus pineale beyond normal range of var. computed with $\pm 3\ \sigma$		Cases with displacement of corpus pineale beyond normal range of var. computed with $\pm 2.5\ \sigma$		Displacement statistically significant
	Number of cases	% $\pm$ standard error	Number of cases	% $\pm$ standard error	
Total pathological material, 60 cases	14	23.3 ± 5.5	26	43.3 ± 6.4	+
Cases with tumour above tent. cer., 39 cases	14	35.8 ± 7.7	22	56.4 ± 7.9	+
Cases with tumour in post. fossa of skull, 21 cases	—	—	4	19.0 ± 8.6	—

From the figures obtained it is evident that from a statistical viewpoint a definite displacement of the pineal body has thus taken place in 23.3 % of the whole material with a standard error of ± 5.5. The limited number of cases is responsible for the large standard error, but the observations made allow us nevertheless to conclude that a displacement of the pineal body in cases of brain tumour can be considered statistically significant. If those cases are included where the pathological significance of one or more measurements in the individual case is, it is true, less statistically tenable but may be regarded as probable, the percentage becomes considerably larger, namely 43.3 % with a standard error of ± 6.4.

From the table 1 it further appears that a displacement of the pineal body takes place in a still greater percentage of cases with a good statistical safety margin in those cases, where the tumour is located above the tentorium; i. e. a displacement of certainty in $35.8\ \% \pm 7.7$ and a displacement of probability in 56.4 ± 7.9.

On the other hand no statistical probability of any displacement of the pineal body has been found in those cases of my material (this being, however, relativly small) where the tumour is located in the posterior fossa of the skull. The difference between the percentages — with displacement of probability of the pineal body — when the tumour

is situated above and below the tentorium is 37.4 ± 4.1. This difference is statistically significant.

The following table purports to show which tumours in the different parts of the brain cause displacement of the pineal body.

Table 2

	Number of cases	Number of cases with displacement of corp. pin. beyond normal range of var. computed with	
		$\pm 3\ \sigma$	$\pm 2.5\ \sigma$
Tumours of frontal lobes	8	2	3
» » central convolutions	5	2	2
» » parietal lobes	1	—	—
» » occipital lobes	1	—	—
» » temporal lobes	11	4	8
» » hypophysis	4	1	2
» » crus cerebri	7	3	5
» » uncertain position above tentorium	2	2	2
» » posterior fossa of skull	21	—	4

Because of the small number of cases in each group no statistical calculation is here indicated.

SUMMARY

Differentiation between the normal and pathological position of the pineal body can only be reliably established by statistical methods. No such statistical investigation has hitherto been carried out. The author has therefore in a series of 200 cases presenting no roentgenological or clinical signs of any expansive intracranial processes, determined statistically the normal position of the pineal body and its variability by measurements on radiograms. The disposal of Dr. H. OLIVECRONA's material of verified brain tumours enabled a similar localization to be carried out in 60 cases of tumour. In a great number of these cases a displacement of the pineal body was found beyond the limits of normal variation. Localization of the pineal body is therefore a valuable aid in the diagnosis of expansive intracranial processes.

ZUSAMMENFASSUNG

Der Unterschied zwischen der normalen und pathologischen Lage der Zirbeldrüse kann nur durch statistische Methoden verlässlich festgestellt werden. Bisher war keine derartige statistische Untersuchung ausgeführt worden. Der Verf. hat deshalb an einem Material von 200 Fällen, die weder röntgenologische noch klinische Zeichen eines expansiven intrakranialen Prozesses zeigten, statistisch die normale Lage der Zirbeldrüse und ihre Variabilität nach Messungen an Radiogrammen bestimmt. Die Benut-

zung von Dr. H. Olivecrona's Material von verifizierten Hirntumoren ermöglichte es, die Feststellung der Lokalisation in 60 Tumorfällen auszuführen. In einer grossen Zahl dieser Fälle wurde eine die normalen Variationsgrenzen überschreitende Verlagerung der Zirbeldrüse gefunden. Die Lokalisation der Zirbeldrüse ist eine wertvolle Hilfe für die Diagnose von expansiven intrakranialen Prozessen.

RÉSUMÉ

La différenciation entre la position normale et pathologique de la glande pinéale ne peut être convenablement établie que par la méthode statistique. Aucune recherche de cet ordre n'a été faite jusqu'ici. C'est pourquoi l'auteur a, dans un matériel de 200 cas ne présentant ni signes radiologiques ni signes cliniques de processus expansif intracranien, déterminé statistiquement la position normale de la glande pinéale et ses variétés après mesures prises sur des radiogrammes. La mise à sa disposition du matériel du Dr H. Olivecrona de tumeurs cérébrales vérifiées lui a permis de faire des recherches analogues dans 60 cas de néoplasme. Dans un grand nombre de ces cas, il a constaté des déplacements de la glande pinéale au-delà des variations normales. La localisation de la glande pinéale est d'un secours précieux pour le diagnostic et la localisation des processus expansifs intra-craniens.

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AUS DER PATHOLOGISCHEN ABTEILUNG DES KRANKENHAUSES SABBATSBERG.
VORSTAND: PROF. H. BERGSTRAND

EIN FALL VON CHONDROBLASTISCHEM SARKOM[1]

von

S. Hammarström

(Tabula XCVI)

Die Einteilung der osteogenen Sarkome in klinische und pathologisch-anatomische Gruppen bietet grosse Schwierigkeiten. KOLODNY unterlässt in seiner grossen Monographie jeglichen Versuch, gibt aber seiner Meinung Ausdruck, dass ein weiteres Eindringen in die Frage sicherlich zu einem fruchtbringenden Einteilungsgrund führen werde.

GESCHICHTER und COPELAND nahmen eine Einteilung der Knochensarkome auf histogenetischer Grundlage vor und gelangten auf diesem Wege zu einer Abgrenzung verschiedener Gruppen mit deutlichen klinischen, röntgenologischen, makro- und mikroskopischen charakteristischen Merkmalen.

Ich will nicht versuchen, hier eine Übersicht über die Einteilung der Knochentumoren durch die genannten Verfasser und deren Beschreibung der Knochenentwicklung zu geben, sondern nur in Kürze die Hauptzüge dieser Einteilung anführen. Sie trennen zuerst eine Knochentumorengruppe ab, die das Myelom, Ewings Sarkom, Fibrosarkom, das neurogene Sarkom und Karzinommetastasen umfasst. Die übrigen teilen sie in zwei Hauptgruppen auf, eine von Geschwülsten, die aus präkartilaginärem Bindegewebe hergeleitet werden können, und eine zweite, die in Beziehung zur späteren Knorpelentwicklung steht. In der letzteren Gruppe findet man eine seltene Sarkomform, die sie chondroblastisches Sarkom nennen. Im ganzen Material von COPELAND und GESCHICHTER, das 360 osteogene Sarkome umfasst, sind nur 24 dieser Art enthalten. Trotzdem die chondroblastischen Sarkome, die äusserst malign sind, von den übrigen osteogenen Sarkomen gut abgegrenzte Charakteristika haben, kann ihnen wegen ihrer geringen Frequenz keine grössere klinische Bedeutung beigemessen werden; da sie aber vom histogenetischen Gesichts-

[1] Bei der Redaktion am 6. VI. 1934 eingegangen.

punkte eine überraschend deutliche Abgrenzung bieten, mag ein näherer Bericht über sie im Anschluss an das Referat eines Falles motiviert sein.

Von den in der Literatur beschriebenen Fällen standen 25 in einem Alter zwischen 9 und 24 Jahren und 18 zwischen 15 und 20 Jahren! Nur 3 Fälle sind älter als 24 Jahre. Dass sich diese Tumoren in erster Linie in einer besonderen Altersklasse zeigen, deutet u. a. darauf hin, dass sie an ein besonderes Stadium der Knochenentwicklung gebunden sind, und diese Annahme wird durch die Tatsache bekräftigt, dass sie immer in den Epiphysen auftreten, und zwar vor allem in den Epiphysen der langen Röhrenknochen, wo die Knochenproliferation am lebhaftesten ist. So sind von den 28 Fällen 9 im unteren Teil des Femur lokalisiert, 8 in der oberen Tibiapartie, 6 im oberen Humerusteil und je ein Fall im unteren Teil von Radius, Collum scapulae und Ileum. Die Anamnese berichtet für Patienten unter 25 Jahren über Beschwerden von 1 Monat bis 1 Jahr, durchschnittlich von ungefähr 4 Monaten. In den vereinzelten Fällen über 30 Jahre kommt indes eine Dauer bis zu 3 Jahren vor. Ein Trauma ist in der Anamnese bei mehr als $^1/_3$ der Fälle erwähnt. Schmerz, Empfindlichkeit, Schwellung und Funktionsstörung sind die gewöhnlichen Symptome. Fieber, Leukozytose und Schwellung der regionären Lymphdrüsen kommen oft vor. Röntgenologisch ist besonders in den frühen Stadien die nahe Beziehung zur Epiphysenlinie der hervortretendste Zug. Eine zentrale Knochendestruktion mit einem in späteren Stadien zystischen Aussehen sowie einer markierten periostalen Verdünnung ist ein weiteres Kennzeichen bei dem Röntgenbild, das oft demjenigen bei benignen Riesenzellentumoren ähnelt. Die letzteren, die gleichfalls meistens in der Epiphyse auftreten, jedoch am häufigsten bei Patienten über 20 Jahren, haben eine grobtrabekuläre Struktur und keine periostale Reaktion.

Obgleich die chondroblastischen Sarkome zentralen Ursprungs sind, können sie in der Epiphysenlinie den Kortex durchwachsen. In solchen Fällen ist das Periost durch eine Schichte abgehoben, die einen durchsichtigen Schatten gibt. Die für das sklerostische osteoblastische Sarkom typische und wohlbekannte Spikulabildung fehlt aber. Das chondroblastische Sarkom verbreitet sich nach beiden Seiten der Epiphyse, und auf dem Röntgenbilde sieht man bei solchen Fällen in das Innere der Diaphyse eindringende langgestreckte Verdünnungen. Die Übereinstimmung betreffs des Alters des Patienten, die akuten Symptome und die Prädilektion für die langen Röhrenknochen können zu Verwechslung mit Ewings Sarkom führen, beim letzgenannten Leiden ist aber die Knochenbildung ausgesprochener, und die Infiltration der Diaphyse mehr diffus. Man sieht bei Ewings Sarkom niemals eine so ausgesprochene epiphysäre Lokalisation wie beim chondroblastischen Sarkom.

Das makroskopische Aussehen weist mittunter Ähnlichkeit mit einer organisierten Blutung auf — eine dunkelrote, geleeähnliche Masse mit eingestreuten Stücken von nekrotischem Knochen —, andere Male dagegen ist die Geschwulst von festerer Konsistenz mit grauen oder blauweissen durchscheinenden Partien, die hyalinem Knorpel gleichen. Im Gegensatz zu anderen Chondrosarkomen sind syrup- oder geleeähnliche Massen

Fig. 1. Durchgesägtes Amputationspräparat; am lateralen Tibiakondylus ist die Epiphysenlinie vom Tumor unterbrochen, der von einer sklerotischen Zone umgeben ist.

von durchsichtigem myoxmatösem Material oder zystische Degeneration für die Geschwulst nicht charakteristisch. Bezüglich der Topographie ist die enge Beziehung zur unverknöcherten Epiphysenlinie das bezeichnendste. Auf durchsägten Amputationspräparaten kann man diese Linie deutlich bis zu dem Punkte verfolgen, wo die Geschwulstproliferation beginnt (siehe Fig. 1).

Bei mikroskopischer Untersuchung findet man, dass die Geschwulstzellen frappierende Ähnlichkeit mit denjenigen haben, die sich vorfinden, wo das Blastem im embryonalen Skelett zu Knorpelzellen differentiiert wird; ausserdem sieht man jüngere und ältere Knorpel-

zellen von wenig ausgesprochener Differentiierung. Züge von Myxomgewebe oder so genanntem präkartilaginärem Bindegewebe sind nicht zu beobachten. Ein wichtiges Verhalten, das dieses Neoplasma von den osteoiden Sarkomen unterscheidet, ist, dass es keinen Knochen bildet. Peripher werden allerdings Knochenstücke beobachtet, da diese aber nur in der reich vaskularisierten und mit zahlreichen Riesenzellen versehenen Randzone vorkommen, können diese Knocheninseln entweder nach COPELAND und GESCHICHTER als neugebildeter, durch die reizende Einwirkung der Geschwulst entstandener Knochen erklärt werden, oder als Reste einer von den Gefässen ausgehenden Knochenresorption. In den Metastasen kann man niemals Knochenneubildung beobachten und auch keine Riesenzellen, die sonst in reichlicher Menge vorkommen. Die Zellen differentiieren eine spärliche Menge Kollagen, das allertypischeste ist aber, dass Kalk interzellulär ausgefällt wird, und ferner, dass die Geschwulst reich vaskularisiert ist und zahlreiche Riesenzellen enthält. Mitosen sind sehr selten.

Die Prognose ist schlecht. Unter COPELAND und GESCHICHTERS 24 Fällen kommen nur zwei Fünf-Jahres-Heilungen vor, von welchen eine einen 30jährigen Patienten betrifft. Beide Fälle wurden strahlenbehandelt, ausserdem war Auskratzung resp. Amputation vorgenommen worden. Als richtige Behandlung wird Amputation und ausserdem intensive prä- und postoperative Strahlenbehandlung angegeben. Die Knorpelsarkome sollen nach Angabe mehrerer Verfasser leichter beeinflussbar sein als osteogene Sarkome im allgemeinen, sind jedoch keineswegs so strahlenempfindlich wie beispielsweise die Ewingschen Sarkome.

Aus Professor H. BERGSTRANDS gut durchgearbeiteter Sammlung von osteogenen Sarkomen erhielt ich folgenden Fall von chondroblastischem Sarkom zur Publikation.

Der Fall betrifft einen 17jährigen Motorarbeiter, der im Mai 1933 das Krankenhaus in Södertälje (Chefarzt NORMANN) wegen Schwellung und Schmerzen im rechten Knie aufsuchte, das dem Pat. einen Monat lang Beschwerden verursacht hatte. Die Schwellung hatte zugenommen, Pat. hatte zu Bett gelegen und war mit feucht-warmen Umschlägen behandelt worden, wobei sowohl die Schwellung als auch die Schmerzen abgenommen hatten; da sie aber nicht ganz verschwinden wollten, wurde Pat. am 31. V. 1933 in das Krankenhaus in Södertälje aufgenommen.

Status: Allgzstd gut. Beiderseits kongenitale Klumpfüsse. Rechtes Kniegelenk: leicht spindelförmig aufgetrieben, mit etwas »Tanzen» der Patella. Kapselverdickung. Lateral, ungefähr dem Capitulum fibulae entsprechend, eine leichte Auftreibung und an dieser Stelle auch etwas Palpationsempfindlichkeit.

Am 1. VI. zeigte die Rtg.-Unters. des r. Kniegelenks eine spanischnussgrosse rundliche Destruktion mit leicht sklerosierter Umgebung in der hinteren Hälfte des lateralen Tibiakondylus (Fig. 2).

Probeexzision am 14. VI. zeigte nur Kapsel- und Periostreste ohne pathologische Veränderungen.

Pat. bekam einen Kniegipsverband und wurde mit der Diagnose Synovitis gen. dx. entlassen.

Wiederaufnahme am 12. VII. zur Kontroll-Röntgen-Aufnahme, die ein unverändertes Bild der Knochenveränderung zeigte. Das r. Kniegelenk wies jetzt bei Palpation keinerlei Schwellung oder Empfindlichkeit auf. Kein Tanzen der Patella. Am 17. VII. bei subj. Wohlbefinden entlassen.

Nach einem Monat kam Pat. zwecks neuerlicher Kontrolle wieder. Seit dem vorigen Spitalsaufenthalt war er ausser Bett gewesen und immer mehr gegangen. Die Beschwerden dauern fort, Schmerzen nach dem Gehen, »Sehnenschmerzen», leichte Schwellung. Lokalstatus: R. Oberschenkelmuskulatur atrophisch. Das r. Knie zeigt eine Anschwellung über dem oberen vorderen Teil der Tibia; nicht schmerzhaft. Unbedeutende Empfindlichkeit über dem Ansatz der Bizepssehne und medial davon. Kapselverdickung. Kein Tanzen der Patella. Die Patella ist nicht so frei beweglich wie auf der l. Seite. Die Beweglichkeit bei Flexion unbedeutend eingeschränkt; Extension frei. Keine Schmerzen bei Bewegung.

Bei Röntgenuntersuchung am 17. VIII. zeigte die Destruktion im lateralen Tibiakondylus eine deutliche Zunahme. Sie misst nun auf dem Frontalbilde 25 × 24 mm gegen 23 × 21 mm vor einem Monat, und hat jetzt eine Andeutung von Buckligkeit in der Kontur. Die Begrenzung ist aber jetzt ebenso wie bei der vorigen Untersuchung scharf, mit leichter Sklerosierung. (Fig. 2.)

Am 19. VIII. wurde Inzision, Auskratzung und Dränage vorgenommen. Präp. zur P. A. D. zeigte einen malignen Tumor der aus atypischen runden und spindelförmigen Zellen sowie mehrzelligen Riesenzellen aufgebaut war. Die Kerne der letzteren waren im allgemeinen gleich gross. Die Tumorzellen, die im allgemeinen gleiche Dimension zeigen, haben den Charakter eines undifferentiierten Bindegewebsblastems, das knorpelähnliches Gewebe differentiiert. Die Geschwulst enthält spärlich kollagene Züge und stellenweise reichliche Chondrinentwicklung, die verwischte Partien in dem sonst homogenen Bilde bedingt. (Fig. 3 und 4.)

8. IX. Allgzstd gut. Die Wunde am einen Bein geheilt, hier keine Schmerzen, keine Beschwerden von den Lungen, auch keine anderen Symptome von Metastasen.

28. VIII. Lungenröntgenaufnahme zeigt weder Parenchymveränderungen noch Zeichen von intrathorakalen Tumormetastasen. Keine Destruktionen im Thoraxskelett.

12. IX. Amputation des r. Oberschenkels ungefähr an der Grenze zwischen dem mitteleren und unteren Drittel. Auf dem durchgesägten Amputationspräparat sieht man, wie der Epiphysenknorpel durch den rundlichen Tumor unterbrochen ist. Der letztere ist von einer breiten sklerotischen Zone umgeben, ausser an derjenigen Stelle der Epiphysenlinie, von wo der Tumor sich nach oben auf den proximalen Teil des Beines ausbreitet (Fig. 5). Dieses Bild mit einem in der Epiphysenlinie lokalisierten Durchbruch des Tumors durch die sklerotische Randzone wird als ein typisches Merkzeichen für das chondroblastische Sarkom angegeben.

26. IX. Der postoperative Verlauf gut. Die Heilung verläuft normal. 7. X. Geheilt entlassen. Pat. gibt an, dass er ab und zu leichte Schmerzen im Amputationsstumpf habe.

Epikrise. Ein 17jähriger Jüngling wird zwei mal durch $1^1/_2$ Monate unter der Diagnose Synovitis gen. dx. behandelt. Beschwerden in Form leichter Schwellung, Druckempfindlichkeit und Schmerzen beim Gehen seit einem Monat vor dem ersten Spitalsaufenthalt. $2^1/_2$ Monate nach

Einsetzen der Symptome wird Pat. zum dritten Male mit ähnlichen Symptomen aufgenommen, und da nach Probecxzision die Diagnose Sarkom gestellt worden war, und man keine Zeichen von Metastasen beobachtete, wird nach $4^1/_2$ monatigem Krankheitsverlauf Amputation vorgenommen. Die P. A. D. lautete auf Grund des Operationspräparates chondroblastisches Sarkom.

Solche Fälle bieten grosse differentialdiagnostische Schwierigkeiten. wenn man die Arbeiten von COPELAND und GESCHICHTER nicht kennt. Die Lage ist für jede andere Form von osteogenem Sarkom atypisch. Das Röntgenbild zeigt auch keine periostale Reaktion in Form von Spikulabildung, und es liegt keine Knochenbildung vor. Bei mikroskopischer Betrachtung kann der fast völlige Mangel an Mitosen zusammen mit dem reichlichen Vorkommen von Riesenzellen zu einer Verwechslung mit einem benignen Riesenzellentumor führen. Das mikroskopische Bild ist hier durchgehend gleichartig und steht in scharfem Gegensatz zum ausgesprochenen Polymorphismus, den man bei anderen osteogenen Sarkomen findet.

Das grösste Interesse bietet dieser Tumor vom histogenetischen Standpunkte. Als erstes sei hier die ausgeprägte Prädilektion des chondrogenen Sarkoms zu den am stärksten prolieferierenden Epiphysenknorpeln, d. h. zu den Epiphysen der langen Röhrenknochen hervorgehoben, sowie das Vorkommen in derjenigen Altersklasse, in der sich die Epiphysengrenzen schliessen. Am auffälligsten ist indes die Ähnlichkeit, die dieser Geschwulsttypus mit der Entwicklung des Mesenchyms zu Chondroblasten hat, die dann Chondrin und Kollagen ausbilden. Man findet auch Bilder, die den Knorpelstäbchen analog sind, um welche die enchondrale Verknöcherung vorsichgeht, welche Stäbe in ihrem Innern rasch proliferierende Chondroblasten zeigen, die sehr bald degenerative Formen annehmen, mit grossen, hellen Endoplasmagebieten und verwischtem, chondringesättigtem, kollagenarmem Exoplasma, wo es schliesslich zu einer Sklerosierung, d. h. einem Kalkniederschlag kommt.

Ein wichtiges Charakteristikum für die chondrogenen Sarkome ist, wie oben erwähnt, der Umstand dass sie kein Knochengewebe ausbilden, was sich auch in den Weichteilsmetastasen zeigt. Dies ist ein wichtiger Unterschied von den anderen osteogenen Sarkomen, die vom histogenetischen Standpunkte Osteoidgeschwülste sind, mit den für das Osteoid bezeichnenden Eigenschaften, alle Gewebe bilden zu können, die in der Osteogenese vorkommen.

Die Zone von Riesenzellen, die man in der Peripherie der chondroblastischen Sarkome findet, kann nämlich der Zone von zahlreichen Gefässen und dem an Riesenzellen reichen Knochengewebe analog gestellt werden, die man an der Knorpelgrenze der enchondralen Verknöcherung sieht. Die Riesenzellen, die nur im Primärtumor, aber nicht in den Metastasen

vorkommen, verdienen eine besondere Erörterung. COPELAND und GESCHICHTER schliessen sich in mehreren Arbeiten bei ihrer Darstellung der Natur der Riesenzellen an die Osteoklastentheorie an und beschreiben sie also als aktive Elemente, die den Zerfall des Knochengewebes hervorrufen, in dem sie vorkommen. Fasst man die Versuche ins Auge, die gemacht wurden, um diese Theorie mit den Erfahrungen zu vereinen, die sich aus dem Studium der pathologischen Veränderungen im Knochengewebe ergeben, so begegnet man gewissen Inkongruenzen. Schon in der Gruppe benigner Tumoren, die Riesenzellentumoren genannt werden, weisen COPELAND und GESCHICHTER nach, dass traumatische und nachfolgende vaskuläre Störungen die primäre Ursache des Knochenzerfalls sind. Unter diesen Umständen ist es schwer, in den Riesenzellen aktive knochenzerstörende Elemente zu sehen. Eine weit bessere Erklärung finden sie durch die Theorie HÄGGQUISTS.

Die Riesenzellen werden von HÄGGQUIST bekanntlich als völlig passive Gebilde dargestellt, die als eine Art degenerativer, aus demaskiertem Protoplasma bestehender Produkte auftreten und liegen bleiben, wenn der Kalk und das Kollagen aus dem Knochengewebe verschwunden sind. Diese Riesenzellen sind besonders deutlich dort zu beobachten, wo der Knochenumbau besonders rasch vorsichgeht, z. B. bei jungen Katzen.

Die Riesenzellen in den chondroblastischen Sarkomen, und besonders ihr zahlreiches Vorkommen in den peripheren Teilen, lassen sich gut als degenerative Gebilde bei rasch vorsichgehendem Zerfall des Knochengewebes erklären. Dies würde gut damit übereinstimmen, dass die Weichteilsmetastasen keine Riesenzellen enthalten. Bemerkenswert ist auch, dass die obenerwähnten amerikanischen Verfasser hervorheben, die Riesenzellen kämen am häufigsten dort vor, wo ein akuter Knochenzerfall vorsichgeht. Auch GESCHICHTER und COPELAND sind nicht der Ansicht, dass diese Riesenzellen dem Geschwulstgewebe angehören. Sie schreiben nämlich: »We believe this view, that the gigant cell areas in chondroblastic sarcoma are a product of normal reacting bone, nearer the truth than the supposition that they are a further stage in the malignant osteogenesis of cartilaginous bone by the sarcomatous chondroblasts. Since we can observe the death of the chondroblasts with the formation of the calcified matrix, we do not see how they could survive to initiate the giant cell phase, as a further malignant product. The fact that giant cells are more numerous at the tumor margin at the site of normal reactive bone also supports this view.» Ob man nun die Riesenzellen als Osteoklasten oder als degenerative Gebilde betrachtet, es gibt nichts, was dafür spricht, dass die Riesenzellen in den chondroblastischen Sarkomen dem eigentlichen Geschwulstgewebe angehören.

Fig. 2. Röntgenbild von der Destruktion im lateralen Tibiakondylus. Leicht sklerotische Umgebung.

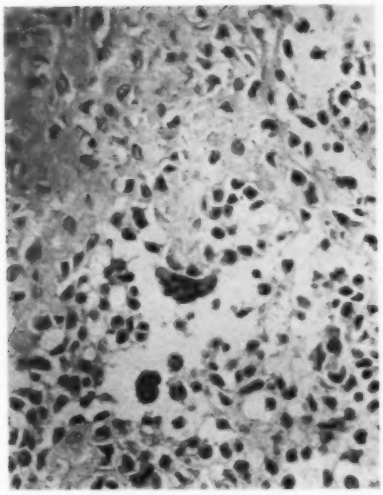

Fig. 3. Mikroskopisches Bild des Geschwulstgewebes. Zwei Riesenzellen von Epulid-Typus.

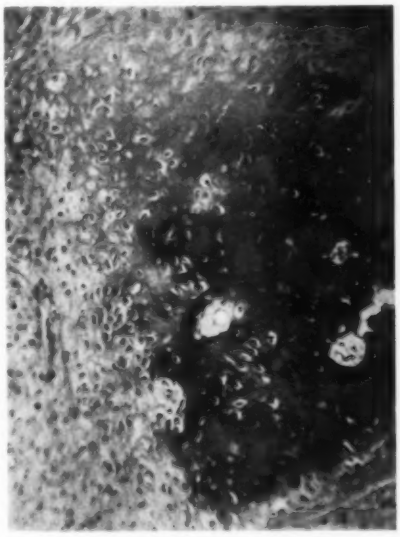

Fig. 4. Mikroskopisches Bild des Geschwulstgewebes. Knorpelgewebe und Vorstadien von Knorpelgewebe.

Fig. 5. Querschnitt durch den Tumor bei geringer Vergrösserung. Man sieht das Verhalten des Geschwulstgewebes zum Epiphysenknorpel (*E*) und zum Gelenkknorpel *A*). Die sklerotische Randzone ist deutlich wahrnehmbar.

Bei der Beschreibung des Längenwachstums der mit Epiphysenknorpel versehenen Knochen pflegt man von einem Wettlauf zwischen der Entwicklung des Epiphysenknorpels und des enchondralen Knochens zu sprechen. In der peripheren Zone der chondroblastischen Sarkome kann man, von den oben zitierten Gesichtspunkten ausgehend, vom selben Wettlauf sprechen, wobei aber hinzuzufügen ist, dass hier die benigne enchondrale Verknöcherung von der malignen Knorpelproliferation unfehlbar überholt wird, und das einzige Resultat dieses Wettlaufs würde sein, »dass die Riesenzellen den Pathologen auf Irrwege führen und ihn glauben machen können, dass sich das ganze um einen sogen. Riesenzellentumor handle» (COPELAND und GESCHICHTER).

Wie schon erwähnt, haben die chondroblastischen Sarkome eine, nach den oben erwähnten 28 Fällen zu urteilen, äusserst schlechte Prognose. Von Interesse ist indes, dass CODMAN 9 Fälle von sogen. Riesenzellentumoren publizierte, die vom oberen Epiphysenknorpel des Humerus ausgegangen waren, und die, sowohl was das Röntgenbild als auch die Dauer und das klinische Bild überhaupt betrifft, mit dem übereinstimmen, was man beim chondroblastischen Sarkom findet. Alle diese Fälle hatten indes einen benignen Verlauf. Einer von ihnen wurde ausser von CODMAN auch von KOLODNY und PHEMISTER ausführlich mit schwebender Diagnose, und von GESCHICHTER und COPELAND als chondroblastisches Sarkom beschrieben. Die letzteren sind auch geneigt, sämtliche 9 Fälle als chondroblastische Sarkome zu betrachten. In allen diesen 9 Fällen handelt es sich um Patienten im Alter zwischen 9 und 12 Jahren, also um etwas jüngere, als diejenigen, bei welchen man durchschnittlich die chondroblastischen Sarkome findet.

Es scheint also, als ob es möglicherweise bei Kindern eine benigne Form von chondroblastischem Sarkom geben würde.

ZUSAMMENFASSUNG

Verf. gibt einen Bericht über das chondroblastische Sarkom im Anschluss an ein Referat eines typischen Falles. Von diesem Sarkom wurden bis jetzt nur 27 Fälle beschrieben, sämtliche in der amerikanischen Literatur. Verf. hat die röntgenologischen, klinischen und pathologisch-anatomischen Charakteristika des Sarkomes — besonders mit Rücksicht seiner Differentialdiagnose — zusammengefasst. Ein Versuch wird gemacht, die Natur des Sarkomgewebes und speziell der in ihm vorkommenden Riesenzellen zu deuten. Die Möglichkeit einer im Kindesalter auftretenden, benignen Form von chondroblatischem Sarkom wird erwähnt.

SUMMARY

The author reports a case of chondroblastic sarcoma, and with the latter as basis gives a representation of that sarcoma, of which only 27 cases have been described so far, all by American authors. He dwells on the roentgenologic, clinical and patho-ana-

tomical characters of the growth, particularly with reference to its diagnosis from other neoplasms, and attempts to establish the nature of the sarcomatous tissue, especially that of the giant cells contained in the latter. He mentions the possible existence of a benign form of chondroblastic sarcoma, occurring in young children.

RÉSUMÉ

L'auteur donne une description d'un sarcome chondroblastique, à propos du compte rendu d'un cas typique. Il a été décrit jusqu'ici 27 cas de sarcomes de cette nature, tous dans la littérature américaine. L'auteur a réuni les caractéristiques radiologiques, cliniques, et anatomo-pathologiques du sarcome, surtout au point de vue du diagnostic différentiel. Il tente une interprétation de la nature du tissu sarcomateux et plus particulièrement des cellules géantes qu'il renferme. Il signale la possibilité d'une forme plus bénigne s'observant pendant l'enfance.

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AUS DER RÖNTGENABTEILUNG DES UNIVERSITÄTSKRANKENHAUSES IN UPSALA.
(CHEF: PROF. H. LAURELL)

EINIGE STUDIEN ÜBER DAS AUSSEHEN DES WEICHEN GAUMENS AN RÖNTGENBILDERN, TEILS BEI NORMALEN UND TEILS BEI EINIGEN PATHOLOGISCHEN ZUSTÄNDEN[1]

von

Sven Roland Kjellberg

(Tabulæ XCVII—XCVIII)

Der weiche Gaumen und das Zäpfchen bestehen grösstenteils aus einer muskulösen Platte, die an der nasalen und oralen Seite von einer Schleimhaut bekleidet ist. An der Bildung dieser Platte beteiligen sich mehrere Muskeln, M. levator und tensor veli palatini, Mm. pharyngopalatinus, glossopalatinus und uvulae. Die ausstrahlenden Sehnenzüge der Mm. uvulae und tensor veli palatini verflechten sich miteinander und bilden die Aponeurosis palatini.

Die Schleimhaut der oralen und der nasalen Seite des Gaumens unterscheiden sich nach SCHAFFER bedeutend von einander. Die orale Seite des weichen Gaumens ist von einem geschichteten Pflasterepithel bekleidet. Die Lamina propria besteht zum grössten Teil aus elastischen Fasern, zwischen denen lymphoide Zellen spärlich eingesprengt liegen. Die Submukosa enthält ein mächtiges Lager von Schleimdrüsen, die grösstenteils in ein verhältnismässig gut entwickeltes Fettlager eingebettet sind.

Die nasale Fläche des weichen Gaumens ist von einem mehrreihigen Flimmerepithel, die eine ziemlich gut entwickelte Basalmembran hat, bekleidet. Unter dieser folgt eine 20—50 μ breite Schicht lymphoider Zellen. Zum Unterschied von der oralen Seite fehlt hier eine Submukosa, und die Lamina propria, der Fett fehlt, wird nur durch ein dickes Lager elastischer Fasern von der unterliegenden Muskulatur getrennt.

Der lockere Bau, besonders der oralen Seite, und das Vorhandensein lymphoiden Gewebes, das am besten an der nasalen Seite entwickelt ist, praedisponiert zur Schwellung des weichen Gaumens bei ödematösen und entzündlichen Prozessen im Rachen und bei Hypertrophie des

[1] Bei der Redaktion am 21. VIII. 1934 eingegangen.

lymphoiden Rachenringes. Schon seit langem war man sich dessen bewusst, dass man bei entzündlichen Prozessen eine Schwellung des weichen Gaumens erhält, wovon man sich leicht durch orale Inspektion überzeugen kann. Da man aber die hintere Seite des Velums ohne Spiegel nicht beobachten kann, stosst man oft auf Schwierigkeiten, den Grad der Schwellung des weichen Gaumens zu beurteilen. Bedeutend einfacher gelingt dies jedoch durch die röntgenologische Untersuchung, da man bei geeigneter Projektion und bekanntem Abstand die Dicke des weichen Gaumens an Röntgenbildern ziemlich genau messen kann.

Um die Grenzwerte, zwischen denen die Dicke des weichen Gaumens unter normalen Verhältnissen schwankt, zu ermitteln, wurden an Leichen, die klinische und pathologisch-anatomische Zeichen von Veränderungen an Nase und Rachen vermissten, Messungen gemacht. In 70 der untersuchten Fälle erhielt man Werte, deren Grenzen bei Erwachsenen zwischen 7—9 mm., bei Kindern (zwischen 8 Mon. und 12 Jahren) zwischen 5—8 mm. schwankten. Diese Werte können natürlich nicht ohne weiteres als Normalmasse beim lebenden Menschen angenommen werden. Zufolge des verminderten Turgors des Gewebes wie auch der Erschlaffung der Muskulatur nach dem Tode ist der Querschnitt des Gaumens immer schmäler an der Leiche als beim Lebenden. Diese Verminderung der Dicke berechnet man auf eine Kleinigkeit und dürfte höchsten $1^1/_2$ mm. betragen.

Schon am Ende des 19. Jahrhunderts hatte man begonnen den weichen Gaumen zu studieren. Da die Röntgentechnik dieser Zeit es nicht ermöglichte, deutliche Bilder zu verfertigen, bediente man sich hauptsächlich der Durchleuchtung, und schon 1897 beschreibt SCHEIER seine Beobachtungen am Durchleuchtungsschirm. Mit der Entwicklung der Röntgentechnik verbesserte sich nach und nach die Möglichkeit, das Aussehen des weichen Gaumens zu studieren. Um deutliche Bilder zu erhalten, verwendete man früher oft ein Kontrastmittel. So z. B. legten BARTH 1906 und MEYER 1907 eine Kette längs der Zunge und eine andere durch die Nase längs dem Velum, HAUDEK und FRÖSCHELS 1910 belegten die Zunge, den Gaumen und die hintere Rachenwand mit Bi-carbonat, während GUTZMAN 1930 Goldschlägerhaut + Bariumsulfat benutzte. Seit vielen Jahren ist es doch gelungen bei geeigneter Technik deutliche Bilder vom Epipharynx und den weichen Gaumen auch ohne Kontrastmittel zu erhalten, was u. a. von SZÉKACS-FRIEDMAN 1932 und von GROTH 1934 beschrieben wird. Es war indessen weniger das normale und pathologische Aussehen des Gaumens als vielmehr seine Bewegungen beim Sprechen und Schlucken, was im Laufe der vergangenen Jahre die verschiedenen Verfasser interessiert hat.

Bezüglich der Technik beim Photographieren des weichen Gaumens ist zur Bestimmung der Dicke das reine Seitenbild das geeigneste. Das Einführen eines Kontrastmittels in Mund und Epipharynx ist un-

nötig. Bei kurzem Fokalabstand (etwa 70 cm)., den man unter anderem bei dem älteren Schädelaufnahmegerät LYSHOLM's benutzt, erhält man oft befriedigende Bilder in liegender Stellung. Das beste Resultat aber erhält man, wenn Pat. in einer verhältnismässig grossen Entfernung (z. B. in einem Fokalabstand von $1^1/_2$—2 m.), mit dem Kopf etwas zurückgebeugt und mit Stütze für Hinterhaupt und Rücken, sitzend photographiert wird. Der Mund soll etwas offen gehalten werden, und um die Gaumenmuskulatur zu entspannen soll der Pat. während des Photographierens nur sehr leise durch den Mund atmen. Dadurch riskiert man auch nicht, dass die Gaumen- und Zungenschatten in einander übergehen; diese Teile werden anstatt dessen durch eine kleine Luftspalte von einander getrennt. Es ist ausserdem zweckmässig den Film in einiger Entfernung vom Kopf (LAURELL) mit z. B. einem Lysholmschen Raster als Sekundärblende zu stellen. Beide Massregeln tragen dazu bei den Kontrast zu vermehren. Die hier unten wiedergegebenen Bilder sind in einem Fokalabstand von 2 m., einem Filmabstand von 20 cm., bei 115 KW, 80 MA, 0.7 Sek. genommen. Da ich erst in allerletzter Zeit Gelegenheit gehabt habe, LYSHOLM's bewegliche Sekundärblende zu benutzen, sind die meisten Bilder mit LYSHOLM's unbeweglicher Sekundärblende genommen.

Der normale weiche Gaumen zeigt sich am Röntgenbild als ein langgestreckter, fast gleich dicker, in sitzender Stellung herunterhängender, zapfenförmiger Schatten, der sich dem Zäpfchen, zuweilen auch der Basis hin (Ansatz am harten Gaumen) schmälert. Die grösste Dicke in Vivo findet man gewöhnlich unmittelbar kephal der Mitte. Bild I zeigt den weichen Gaumen bei normalen Verhältnissen; der Skizze neben dem Röntgenbild sind einige erläuternde Bezeichnungen beigefügt. Am Bilde sieht man sehr deutlich, wie gut sich der Schatten des weichen Gaumens gegen die Luft in der Mundhöhle und im Epipharynx abgrenzt.

Da das Aussehen des weichen Gaumens von Fall zu Fall ein wechselndes ist, kann ein bestimmter Punkt, wo seine Dicke gemessen werden soll, nicht angegeben werden. Dieses Umstandes wegen sind alle ausgeführten Messungen an der breitesten Stelle gemacht worden. Um ein Normalmass der Dicke des Velums zu erhalten, sind etwa 70 Fälle verschiedenen Alters photographiert worden; alle haben sowohl anamnestisch als auch klinisch jedes Zeichen einer Affektion der Nase und des Rachens entbehrt, weder Vergrösserungen der Tonsillen noch adenoide Wucherungen sind vorhanden gewesen. Bei 40 Erwachsenen belief sich die grösste Dicke auf 12 mm. und die kleinste auf 9 mm. Der erreichte Durchschnittswert von 40 Fällen war 10.5 mm. Bei 30 photographierten Kindern (zwischen 8 Mon. und 12 Jahren) erhielt man im ganzen niedrigere Werte, die grösste Dicke war 11 mm., die kleinste 8 mm., der Durchschnittswert 9.5 mm.

Vergleicht man die an Leichen gefundenen Werte mit diesen, erhält man eine ziemlich gute Übereinstimmung, wenn man auf die Vergrösserung an Röntgenbildern, die bei einem Fokalabstand von zwei m. und einem Filmabstand von 20 cm. ungefähr 1 mm. beträgt, und auf die nach dem Tode eintreffende Erschlaffung des Gewebes nebst dem verminderten Turgor Rücksicht nimmt.

Bei entzündlichen Prozessen erhält man ganz andere Werte. Bild 2. zeigt den weichen Gaumen einer 29-jährigen Pat., die am $^{19}/_{2}$ 34 mit Schnupfen und Halsschmerzen akut erkrankte. Am Bilde, das am $^{20}/_{2}$ genommen wurde, sieht man den weichen Gaumen bedeutend geschwollen, und die grösste Dicke hat ein Mass von 17 mm. Bild 3 ist von derselben Pat. am $^{26}/_{2}$, wo sämtliche Symptome verschwunden waren. Der weiche Gaumen zeigt jetzt eine bedeutende Verminderung der Dicke und er misst jetzt nur 12 mm. Wahrscheinlich ist er noch nicht ganz zur normalen Dicke abgeschwollen.

Bild 4 ist von einem Pat., der ungefähr am $^{16}/_{2}$ 34 an Halsschmerzen erkrankte. Am $^{19}/_{2}$ besuchte der Pat. die hiesige Abteilung für Ohrenkrankheiten, wo man Peritonsillitis konstatierte und ihn noch am selben Abend incidierte. Am Morgen des $^{20}/_{2}$ wurde das Bild genommen. Man sieht hier einen stark vergrösserten, der Spitze hin plump geschwollenen weichen Gaumen, mit einer grössten Dicke von 27 mm. Die Symptome sind nach der Operation rasch zurückgegangen, und am 24. konnte nur eine leichte Röte des Rachens konstatiert werden. Bild 5 zeigt, dass die Schwellung des weichen Gaumens am $^{24}/_{2}$ auffällig zurückgegangen ist und dieser jetzt nur 11 mm. misst.

Bild 6 ist von einem 6-jährigen Pat., der sowohl anamnestisch wie klinisch jedes Zeichen einer Infektion der Nase und des Rachens entbehrte, der aber Symptome adenoider Wucherungen aufwies. Er atmete durch den Mund, schnarchte im Schlafe und hatte ein adenoides Aussehen. Röntgenologisch sind die Sinus normal luftführend. Der weiche Gaumen ist für dieses Alter auffallend dick und hat eine Dicke etwa von 14.5 mm.

Wenn auch die gewöhnlichsten und auffälligsten röntgenologischen Veränderungen des weichen Gaumens in einer Vermehrung der Dicke bestehen, kommt es doch dann und wann vor, dass der weiche Gaumen schmäler als normal ist. So z. B. erhält man bei Pat. mit verbreiteten tuberkulosen Veränderungen der Lunge und des Darmes ein Dickenmass des Gaumens, das die oben angegebenen Normalmasse bedeutend untersteigt. Bild 7 zeigt den weichen Gaumen eines Pat. mit verbreiteten tuberkulösen Veränderungen in Lungen und Darm; die grösste Dicke des weichen Gaumens beträgt 6 mm. Ähnliche Beobachtungen hat schon NEUDA gemacht, seine Angaben aber stützen sich nur auf Inspektion des Rachens. Er sucht die Erklärung dieses Phänomenes in einer Reduktion des Fettes am Velum. Abgesehen davon ob diese Auffas-

sung richtig ist oder nicht, gibt es doch auch andere Faktoren, z. B. Muskelatrophie und Verminderung des lymphoiden Gewebes, die dazu beitragen könnten.

Auch Messungen des weichen Gaumens an Leichen Erwachsener mit verbreiteten tuberkulosen Veränderungen, teils in den Lungen, teils im Darm, sind von mir in 5 Fällen gemacht worden. In sämtlichen Fällen war die grösste Dicke 5 mm. Im Vergleich mit dem früher gesagten untersteigt dieses Mass mit wenigstens 2 mm. das angegebene Normalmass des Gaumens an Leichen.

ZUSAMMENFASSUNG

Verfasser hebt hervor dass bei entzündlichen Prozessen im Rachen der Gaumen schwellt und eine höchst bedeutende Dicke erreichen kann. Bei Hypertrophie des lymphoiden Rachenringes kann man auch eine Vergrösserung der Gaumendicke erhalten, was wohl zum Teil auf die Hypertrophie des lymphoiden Gewebes zu beziehen ist.

Unter gewissen pathologischen Verhältnissen kann die Dicke des Gaumens anstatt dessen bedeutend herabgesetzt sein, was aus den untersuchten Fällen mit verbreiteten tuberkulosen Veränderungen hervorgeht.

SUMMARY

The author points out that when inflammatory processes are going on in the pharynx, the soft palate becomes swollen and can attain a very considerable thickness. A lso in cases of hyperthrophy of the lymphoid wall of the pharynx the thickness of the palate sometimes increases; which is probably due, at least in part, to hypertrophy of the lymphoid tissue of the soft palate. On the other hand, the thickness of the palate can under certain pathological conditions become less, as proved by the cases examined by the author, which showed extensive tuberculous changes.

RÉSUMÉ

L'auteur fait valoir que, dans les processus inflammatoires du pharynx, le voile du palais s'œdématie et peut atteindre une épaisseur considérable. Dans l'hypertrophie de l'anneau lymphoïde du pharynx, on peut également constater une augmentation de l'épaisseur du voile du palais qui, partiellement au moins, est sans doute due à une hypertrophie du tissu lymphoïde du voile.

Dans certains conditions pathologiques, l'épaisseur du voile du palais peut, au contraire se trouver notablement réduite, ainsi qu'il ressort de cas examinés dans lesquels on a constaté des lésions tuberculeuses étendues.

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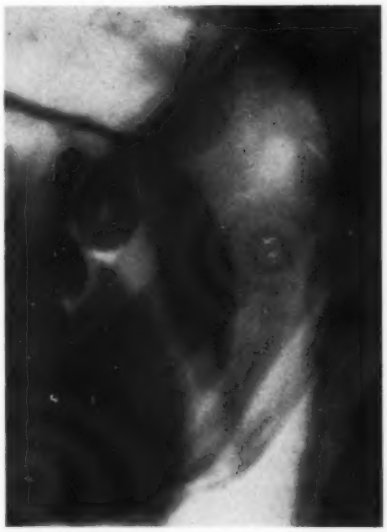


Fig. 1.

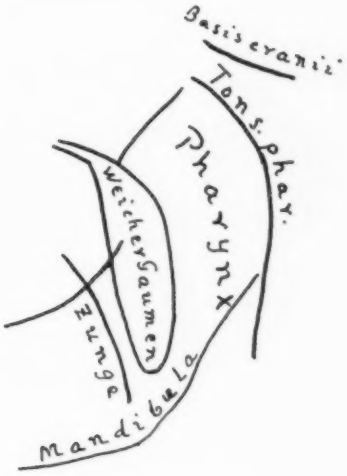
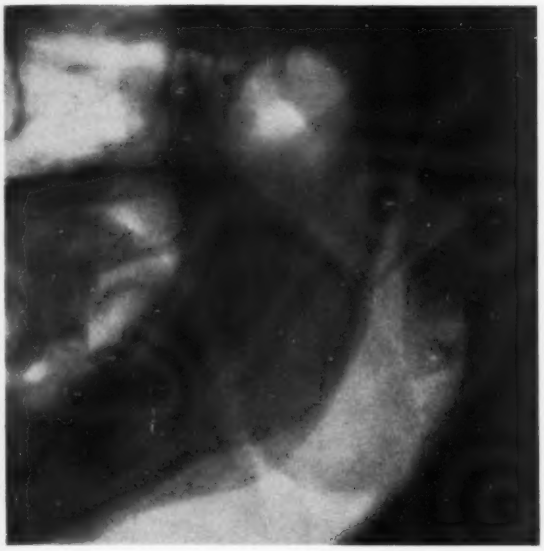


Fig. 2.

Fig. 3.



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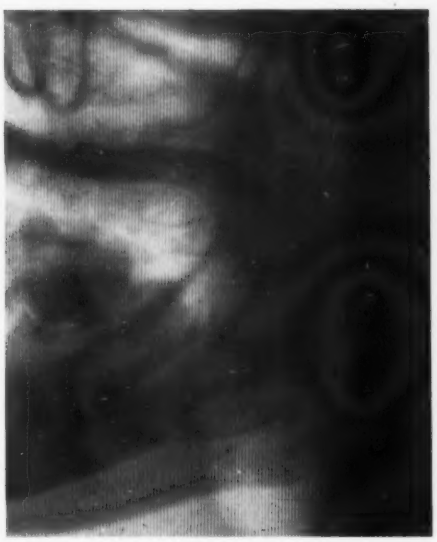

Fig. 5.

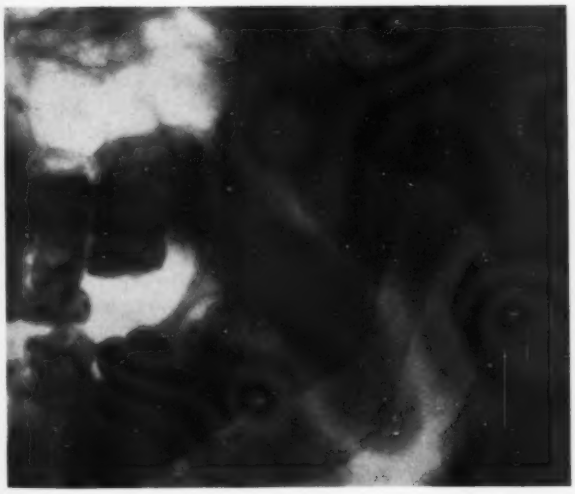

Fig. 6.

Fig. 7.

FROM THE ROENTGENDEPARTMENT OF THE ROYAL SERAPHIMER HOSPITAL, STOCKHOLM.
CHIEF: PROF. G. FORSSELL

ABOUT AXIAL PROJECTIONS OF THE CRANIAL VERTEX[1]

by

Erik Lysholm

(Tabula XCIX)

In general examinations of the skull, we take one frontal projection with the tube angled 20° cranially, one dorsal projection with the tube angled 35° cranially, one axial projection and two sets of stereoscopic lateral projections, one set with the left side against the film and one set with the right side against the film. From these views, however, one cannot determine, with any degree of certainty, the condition of the extreme cranial vertex. Lesions present in this area may not be detected unless such lesions bulge the cranial bones. A clear visualization of this region is especially important in cases of para-sagittal meningeomas.

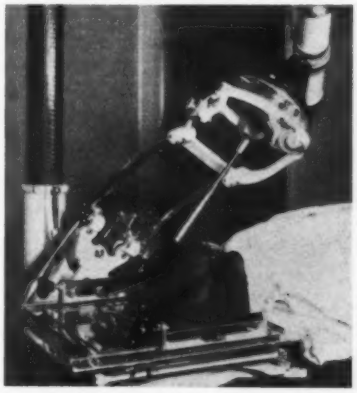

Fig. 1.

The following tangential method is suggested so that satisfactory views may be obtained of the middle para-sagittal region. The patient's head is first placed so that the right side is against the filming table and so that the central ray makes a tangent with the skull vertex when the tube is directly above the table center. The tube is then tilted 30° caudally. This directs the central ray cranially, thus causing it to make a tangent with that portion of the skull nearest the tube. The upper portion of the film is placed within the radius of this ray. This results in an »unfolding» or

[1] Submitted for publication May 28th, 1934.

»laying out» of the sagittal suture and the adjacent portions of the skull nearest the film. By placing the left side against the film a corresponding view of the opposite side is obtained. Together, these views give a good axial preception of the skull vertex, especially those areas about the sagittal suture.

SUMMARY

The author describes a new projection to demonstrate bone and vascular changes in the middle para-sagittal region.

ZUSAMMENFASSUNG

Verf. beschreibt eine neue Projektion zur Demonstrierung von Knochen- und vaskulären Gefässveränderungen in der mittleren parasagittalen Region.

RÉSUMÉ

L'auteur décrit une nouvelle projection permettant de déceler les lésions osseuses et vasculaires dans la région médiane périsagittale.

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Fig. 2. Vascular variations near the sagittal suture.

Fig. 3. Myeloma with destruction at the sagittal suture.

Fig. 4. Parasagittal meningeoma with destruction and vascular changes.

UNIV. OF MICH.

MARIE CURIE

* 7. XI. 1867 † 4. VII. 1934

In Memoriam

Le monde radiologique est plongé dans le deuil. MARIE CURIE, la dernière survivante de la pléiade des grands savants qui, à la fin du siècle dernier, ont créé la science de la radioactivité, nous a quittés. Elle est universellement connue, la merveilleuse histoire de MARIE SKLODOWSKA, la jeune étudiante polonaise qui, jetée sur les chemins de l'exil, trouva en France un refuge et une nouvelle patrie et à qui l'Université de Paris fournit le milieu scientifique propice à l'épanouissement de ses brillantes

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facultés, ce qui lui permit de se placer au premier rang des savants de son temps et de mériter le beau titre de bienfaitrice de l'humanité.

Merveilleux aussi est le destin qui unit MARIE SKLODOWSKA à PIERRE CURIE, son égal dans les annales scientifiques, et qui, faisant de ces deux êtres d'élite des compagnons de travail, leur permit de découvrir la «pierre philosophale», le *radium*, dont les rayons allaient jeter une lumière nouvelle sur les mystères les plus profonds de la matière.

L'histoire de MARIE CURIE emprunte un autre et puissant motif d'intérêt encore à la vaillance et à l'inlassable persévérance avec lesquelles, après la mort tragique de son mari, l'éminente femme paracheva seule leur œuvre commune. Sa vieillesse s'illumina enfin du bonheur de voir sa fille, IRÈNE CURIE, marcher sur les traces de sa mère, s'illustrer à son tour dans le domaine des mêmes investigations et former avec F. JOLIOT un nouveau couple de savants, dont les découvertes s'imposent à l'attention du monde scientifique.

La découverte de la radioactivité du thorium et des nouveaux éléments radioactifs, le polonium et le radium, ainsi que celle de la «radioactivité induite» et les résultats capitaux de ses recherches sur la nature de la radioactivité spontanée ont fait connaître le nom de MARIE CURIE dans le monde entier. Rien ne fait mieux mesurer l'importance de ses travaux que les répercussions fécondes de ces découvertes sur de vastes domaines de la culture humaine. Les impulsions nouvelles que l'étude des nouveaux éléments radioactifs, notamment du radium, a données à la physique, à la chimie et aux sciences connexes, mais surtout les bienfaisants effets des rayons du radium sur les tumeurs cancéreuses excitent l'admiration et la stupéfaction.

La grandeur de la personnalité et de l'œuvre de MARIE CURIE ne tiennent pas moins toutefois à la vigueur et à la pénétration intellectuelles peu communes dont témoignent ses découvertes qu'à l'importance intrinsèque de ces dernières.

A partir du jour où BECQUEREL eut découvert la radiation spontanée de l'uranium, les laboratoires de physique et de chimie les plus renommés se mirent fièvreusement en quête de matière radiante et rivalisèrent d'ardeur pour découvrir l'origine et la nature de cette nouvelle radiation.

MARIE CURIE l'emporta dans cette lutte. Devançant les premiers physiciens et chimistes de son temps, elle fonda l'étude systématique de la radiation spontanée des éléments, à laquelle elle donna le nom de «radioactivité». Et ce premier but, elle l'atteignit en portant à un tel point de perfection la méthode d'examen électroscopique qu'il fut possible de la faire servir à une détermination numérique exacte de la quantité de radiation.

C'est ainsi qu'en 1897 déjà, MARIE CURIE parvint à démontrer que la radioactivité de l'uranium, ainsi que celle du thorium, découvert par elle,

est une propriété relative aux *atomes* et indépendante de l'état physique ou des combinaisons chimiques des éléments. Elle établit par des recherches systématiques, poursuivies sur une grande échelle, que, de tous les éléments alors connus, seuls l'uranium et le thorium ont des propriétés radioactives. En partant de la découverte que la radiation est une propriété atomique, dont la quantité et la qualité sont par conséquent déterminées pour chaque substance radioactive, elle se mit ensuite, armée de l'électromètre, comme d'une baguette divinatoire infiniment sensible entre ses mains, à chercher de nouvelles sources de radioactivité.

Le récit de ces travaux constitue un des chapitres les plus captivants de l'histoire des découvertes scientifiques.

En mesurant l'activité de certains minéraux (pechblende, chalcolite, autunite) qui contiennent de l'uranium ou du thorium, elle constata, fait inattendu, qu'ils avaient une activité plus grande que celle qu'on aurait pu prévoir d'après leur teneur en uranium ou en thorium. C'est ainsi que la chalcolite (phosphate de cuivre et d'urane cristallisé) apparut deux fois environ plus active que l'uranium. MARIE CURIE préparait de la *chalcolite artificielle* en partant de produits purs et obtenait des cristaux dont l'activité répondait exactement à leur teneur en uranium.

Elle pensa alors que l'excès d'activité des minéraux naturels devait être déterminé par la présence d'une petite quantité d'une matière fortement radioactive, différente de l'uranium, du thorium et des corps simples alors connus. S'il en était ainsi, elle pouvait espérer extraire cette substance du mineral par les procédés ordinaires de l'analyse chimique.

A ce stade de ses recherches, PIERRE CURIE unit ses forces à celles de sa femme afin de dépister l'élément radioactif hypothétique.

Les deux investigateurs se mirent aussitôt à l'œuvre, dans l'espoir que la proportion du nouvel élément atteindrait un pourcentage de quelques unités. En réalité, elle était toutefois plus de cent mille fois plus faible. Quoique l'on fût parvenu à accroître la radioactivité des produits chimiques, la matière radiante elle-même semblait échapper aux investigations des chercheurs. Plusieurs années d'un labeur infatigable et heureux furent nécessaires pour démontrer d'une façon indiscutable que la pechblende contenait au moins deux nouveaux corps fortement radioactifs, le *polonium* et le *radium*, et que tous deux sont des éléments, au sens que la chimie attache à cette expression.

Il avait été nécessaire, pour arriver à ce but, de créer une *méthode nouvelle de recherche d'éléments radioactifs nouveaux*, méthode basée sur la radioactivité considérée comme propriété atomique de la matière. Elle consistait notamment à procéder après chaque séparation chimique à un mesurage de l'activité des produits obtenus, à la suite duquel on pouvait se rendre compte de la manière dont la substance active se comporte au point de vue chimique.

Cette méthode, qui présente une certaine analogie avec l'analyse spectrale, est devenue ensuite d'une application générale. Grâce à la grande variété des radiations émises, elle a pu être perfectionnée et développée, en sorte qu'elle permet aujourd'hui, non seulement de découvrir des corps radioactifs, mais aussi de les distinguer les uns des autres avec certitude.

L'analyse électrométrique des éléments radioactifs permet de doser à 1 pour cent près un millième de milligramme de radium et de déceler la présence de 10^{-10} gramme de radium dilué dans quelques grammes de matière. C'était la seule méthode capable de conduire à la découverte du radium, étant donnée la dilution de cette substance dans les minéraux.

Aussi le radiochimiste peut-il, avec son aide, manier couramment au laboratoire des substances dont la présence ne se manifeste que par leurs propriétés radioactives et que l'on peut cependant doser, dissoudre, reprécipiter de leur dissolution et faire déposer par électrolyse.

De nombreux travaux postérieurs ont conduit à envisager l'existence d'une quarantaine d'éléments radioactifs nouveaux, dont seulement un quart environ peuvent être produits toutefois en quantités pondérables. Tous les autres ne peuvent être observés que par leurs propriétés radioactives.

«Il y a là une chimie toute particulière, pour laquelle l'outil d'emploi courant est l'électromètre et non pas la balance et que l'on nommerait volontiers la chimie de l'impondérable» (MARIE CURIE).

La grandeur de l'œuvre de MARIE CURIE ne me semble apparaître pleinement qu'à la lumière de ce fait, que l'isolement du radium n'a pu être réalisé que grâce à la création d'une science toute nouvelle, «la chimie de l'impondérable» ou chimie atomique, et que cette science forme la pierre angulaire de l'édifice constitué par la science de la radioactivité.

Elle est à la base aussi de la production industrielle du radium, qui a mis cette substance à la portée du savant pour ses recherches et au service de la médecine, à laquelle la méthode électrométrique d'examen de la radioactivité, élaborée par les époux CURIE, a permis d'effectuer le dosage de la radioactivité.

L'esprit de MARIE CURIE se mouvait dans une sphère très supérieure à celle de la plupart d'entre nous, et son œuvre la place au rang des plus grands parmi les hommes. Mais elle n'en pourra pas moins nous servir d'exemple à tous, par sa recherche incessante de la vérité, sa conscience incorruptible, son inlassable ardeur au travail et surtout son total oubli d'elle-même dans l'accomplissement de la haute mission qui lui avait été dévolue.

Gösta Forssell.

IVth INTERNATIONAL CONGRESS OF RADIOLOGY ZURICH 1934

Synopsized Abstracts from the Congress

by

E. Berven, J. Heyman, R. Sievert and *N. Westermark*

The Fourth International Congress of Radiology was held in Zurich and St. Moritz on the 24th to the 31st of July, 1934. The first five days of the Congress were spent in Zurich. On Saturday July the 28th only the morning was devoted to scientific work. At 12 a. m. all the members travelled by special train to St. Moritz through the beautiful cantons of Switzerland. After Sunday, a much needed day of rest, the Congress continued two days longer. Over 1000 members had come from 48 different countries.

The formal opening of the Congress took place in the Stadttheater of Zurich with the President of the Congress, Professor HANS SCHINZ, presiding. After Professor SCHINZ' introductory speech, Dr. A. BÉCLÈRE, the President of the Third International Congress, handed over the presidential badge and gavels to the new President and presented a golden cup to the Congress for use at voting ceremonies. After Bundesrat ETTER had welcomed the Congress to Switzerland, the President of the First International Congress, Mr. THURSTAN HOLLAND, expressed the appreciation and thanks of the guests to their Swiss hosts.

The degree of Honorary Doctor was then conferred upon Professor GÖSTA FORSSELL (Stockholm) by the Faculty of Philosophy II of the University of Zurich and upon Professor PAUL SCHERRER of the Eidgenössische Technische Hochschule in Zurich by the Medical Faculty of the University.

The scientific program was abundant both quantitatively as well as qualitatively. The work was divided into 6 sections, röntgen diagnosis, radiotherapy, radiobiology, radiophysics and technique, electrology, and heliotherapy. In the diagnostic section no less than 156 papers were

announced and in the therapeutic section 115, so each of these was divided into 2 groups. 39 papers had been submitted in radiobiology, 50 in radiophysics, 58 in electrology and 17 in heliotherapy.

An extraordinarily fortunate procedure in the organization of the scientific program was the reservation of the mornings for general meetings of the whole congress. The different fields in radiology were then treated by a specially selected reviewer who had to give an introductory survey in 45 minutes. Each group had in addition 4 or 5 assistant reviewers who made shorter 10 minute speeches to throw further light on the problem from different angles.

One volume (Vol. II of the Congressional Proceedings) containing the main papers in extenso and a short résumé of all the others had been printed and distributed one month before the congress to all registered members, so that it was possible to orient oneself in an excellent way as to the problems to be discussed. The speeches given in discussion of many of the abstracts were the result of this system.

The first main topic before the congress was the *organization of the cancer campaign*. In order to throw light upon this important question the congressional board had invited a representative from each of 27 different countries to give a short summary of the organization in the country in question. All of these reports had been printed in German, English and French in a 200 page volume (Vol. III of the Congressional Proceedings) which had been distributed to all the delegates a month before the congress opened. Professor SCHINZ' brilliant survey of these articles gave an interesting picture of the present situation in the campaign against cancer in different countries and the lines of direction for its development.

At the opening ceremony Professor GÖSTA FORSSELL read a paper on the general plan for organization of the campaign against cancer. This was followed by brief reports on this subject from France, America, Belgium and Italy by LEDOUX-LEBARD (Paris), SOILAND (Los Angeles), MAISIN (Louvain) and PALMIERI (Bologna) respectively. Finally Professor SAUERBRUCH (Berlin) gave a paper on »die Grundlagen gemeinsamer Arbeit von Radiologie und Chirurgie», in which he pointed out particularly the great importance of radiology as an independent science in the development of medicine and the necessity of cooperation between the different branches of medicine, especially between surgery and radiology.

W. KIENBÖCK (Wien) had been selected as chief reviewer for Röntgen Diagnosis of Bone Tumours, with the assistance of R. GASSUL (Kasan), E. LOOSER (Winthertur) and R. MATHEY-CORNAT (Bordeaux). Neither KIENBÖCK nor GASSUL were present to give their reviews. LOOSER discussed giant cell tumours which he considers ought to be looked upon

as a form of granuloma, not only on account of the similarity of structure and formation of the solitary giant cell tumours and giant cell tumours in generalized osteitis fibrosa but also because of the same localization tendency in both. There is no doubt that the giant cell tumours are definitely related to an initial hemorrhage. The granulomatous character is also suggested by the fact that hemorrhages in the bone in generalized osteitis fibrosa are often organized by connective tissue rich in giant cells. Giant cell tumours often show a partial or complete conversion to fibrillar connective tissue and by way of this to bony tissue. In this way spontaneous cures often occur. In very rare cases these giant cell tumours do develop into real sarcomas but no oftener than does any other sort of chronic inflammatory tissue.

MATHEY-CORNAT gave an account of 30 cases of his own of bone sarcoma. Of these 19 were osteogenic sarcoma, 6 were Ewing's sarcoma and 5 were fibrosarcoma. All were fatal. The duration of the osteogenic sarcomas was from 6 months to 2 years and 1 month, of the Ewing sarcomas 5 months to 1 year and of the fibrosarcomas 2 to 5 years. The ages of the patients with osteogenic sarcoma varied between 15 and 25 years, with Ewing's sarcoma between 4 and 17 years and with fibrosarcoma between 20 and 25 years. The tumours in no less than 75 % of the cases were situated in the distal end of the femur. The first symptoms were a medullary or subcortical sclerosis and a slight periosteal reaction. The Ewing sarcomas manifested themselves by a more or less marked intramedullary osteolysis.

The chief reviewer for Pulmonary Tuberculosis in the Röntgen Picture was G. HERRNHEISER (Prague) with H. ASSMANN (Königsberg), F. FLEISCHNER (Wien), V. MARAGLIANO (Genova) and N. WESTERMARK (Stockholm) as assistants. HERRNHEISER had limited his survey to problems of current interest in the comparative morphological analysis of the structure of the tuberculous and normal lung. After briefly referring to the definitely established changes such as all larger hard shadows, calcareous flecks, multiple flecked and streaked areas of density, ring shadows and their differential diagnosis, cavity formation etc., the speaker passed on to his main theme, the question of the smaller changes which are difficult to distinguish from the normal lung markings. He gave a very good and thorough description of the normal structure of the lung and its anatomical basis. According to the Zurich anatomist FELIX, each pulmonary lobe is divided into three different sections, »STIEL, KERN und MANTEL». The stalk is formed by the large pulmonary blood vessels and bronchi which are accompanied by nerves, the small bronchial vessels, lymph-nodes and lymphatics. These different parts are held together by connective tissue. The main body consists of an area where the bronchi and vessels of the first, second and third order radiate out

in all directions. The areas between these are filled out by rudimentary lobules. The outer boundary of the main body runs practically parallel to the edge of the lobe at a distance of about 4 cm. from the latter. The mantle is formed by an area of about 4 cm. average width lying around the main body. This area consists chiefly of parenchyma with fully developed lobuli. According to FELIX there are usually 2 layers of lobuli, an outer and an inner. Scattered here and there between them are a number of larger and smaller lobuli. The stalk appears on the röntgen picture as a part of the hilus shadow. All coarser streaks of more than 1.5—2 mm calibre in the meshes of the normal lung picture have their substratum in the main body. Every attempt at careful analysis of the lung picture requires therefore a knowledge of the course and branching of the large vessels and bronchi.

The structure of the mantle is produced by the finest branches of the fourth and fifth order which appear clearly as a fine meshwork only within the apical areas and the peripheral zones of the lungs.

On account of their branching the vessels often meet in the line of direction of the röntgen rays where they appear as flecks. They are characterized by their clear connection with the meshwork of the vessels, by their round often oval form, their sharp borders and their regular arrangement. They are never of greater calibre than the vessels.

Because the vessels can cross one another in different planes, projection shows up other flecks as well on the röntgen picture. These are square or rhomboid and their dimensions correspond exactly to those of the crossing vessels.

These pseudo-flecks are often misinterpreted as pathological areas of density. Often it is only by the direction of the rays that one can distinguish them from pathologic flecks which have in addition an irregular arrangement, often an irregular border and are not of the same size.

ASSMANN read a paper entitled: »Die Darstellung des Frühinfiltrates im Röntgenbild». He showed a number of pictures of the so-called »Frühinfiltrat». He also referred to his well-known point of view on this question.

FLEISCHNER discussed »Die hämatogenen Formen der Lungentuberkulose beim Erwachsenen». Although it has long been considered that chronic pulmonary tuberculosis is chiefly bronchogenic in its origin and spread, more recent investigations have shown that it often develops along hematogenous pathways in the presence of general tuberculosis. There belong here, according to FLEISCHNER, not merely most of the apical pleurites, miliaris discreta of Neumann, Assmann's Rundinfiltrat but also tuberculous bronchitis and peribronchitis.

MARAGLIANO discussed the origin and re-formation of cavities. He pointed out the great service röntgenology has been toward our knowl-

edge in this field. It is not only the classical pathogenesis with liquefaction, cavity formation and the subsequent changes in the walls which play a rôle in cavity formation. Also of great importance in this process are the elastic retraction of the pulmonary tissue, the movements of respiration, pleuropulmonary adhesions and closure of the valves in the afferent bronchi thus leading to positive pressure in the cavities. It may be added that the high negative pressure which occurs in obstruction atelectasis can also play a rôle as JACOBÆUS and WESTERMARK have pointed out.

The fact that cavities can heal spontaneously has often been demonstrated by roentgenological examination.

WESTERMARK discussed »Entwicklung und Vorkommen von Atelektase bei Lungentuberkulose». An account was first given of the different causes of bronchial occlusion in tuberculosis and of the pathogenesis of atelectasis. After a short review of the anatomy of the bronchi and their distribution through the lungs he described the röntgenological and clinical symptoms of atelectasis, the significance of this process and the therapy.

In the two sections where röntgen diagnosis was discussed many interesting papers were read. On account of lack of space only a few of these can be mentioned briefly.

ÅKERLUND, BEHNKEN, BELOT, SCHECHTMANN, THIBONNEAU, RATZKOCZY and BARCLAY spoke on protection against radiation. All of them stressed the importance of careful protection of the patient and personnel during radiological work.

A number of papers were concerned with kymography. STUMPF and CRAMER pointed out its importance in the study of the movements of the stomach and especially in the diagnosis of ulcer and cancer. WEBER gave an account of his own and of his and CRAMER's investigations on the kinetics of the pulmonary lobes which according to these workers are of great importance in the estimation of the value of different surgical procedures on the lung.

A number of speeches were also made on vasography. SANTOS described the technique and indications for the use of this method of examination which seems as if it could be of importance in the diagnosis of tumours, osteomyelitis, tuberculosis and syphilis of the bones.

About 10 papers were concerned with the mechanism of movement of the gastric and intestinal mucous membrane. FORSSELL gave a very much appreciated report on his latest interesting investigations. This was followed by an instructive film.

In the *radiotherapeutic section* one of the main topics was the radiological treatment of tumours of the oral cavity and pharynx. The chief reviewer was Professor PERUSSIA, chief of l'Istituto Vittorio Emanuele

III per lo Studio e la Cura del Cancro di Milano. He stressed the fact that a conception of the results of radiological treatment of these tumours is now possible. These results legitimatize not only the radiological treatment of inoperable and borderline cases but show also that radiological treatment gives better results than surgical even in the operable cases in most tumours of the oral cavity particularly as regards the primary tumour. When treating the operable metastases a combination of radiology and surgery may be the most suitable method.

The speaker pointed out the necessity of a detailed study and a thorough knowledge of the histological structure of the tumours before deciding the plan of treatment. He also stressed the point that the concepts radiosensitivity and radiocurability are in no way equivalent.

A short review was given of the different forms in which the primary tumour may be treated with radium (interstitial radium implantation, surface contact application, teleradium) and with röntgen (especially with Coutard's method).

The speaker also discussed the prognostic significance of metastases and how they should be treated. He mentioned the great importance of the lymph-node apparatus as a protector and barrier against further spread of the cancer and the careful attention which must be paid to this function when treating the lymph-node areas. As in the Swedish and American literature he divides the cases into 3 stages, Group I with non-palpable clinical metastases, Group II with palpable operable metastases and Group III with inoperable metastases. In Group I he recommends exclusively radiological treatment and in Group II a combination of surgical and radiological treatment, perhaps more actively surgical than is in accordance with Swedish principles. However he emphasizes sharply that an incomplete lymph-node dissection, that is, an attempt at operation in borderline and Group III cases, impairs the prognosis and makes the condition of the patient worse than if no surgical procedure at all is undertaken. In Group III with the inoperable cases the only possible technique of treatment is radiological in the form of teleradium or using Coutard's röntgen method.

The importance of early diagnosis and early establishment of the rational therapy were stressed. The possibilities of early diagnosis were discussed with special reference to the instruction of the young students and doctors. PERUSSIA placed the use of propaganda among the general public in a place of secondary importance.

As far as the results of treatment were concerned he considers that if a case has been primarily healed and remains so for at least 1 year, local recurrence from then on is relatively rare. On the other hand it is not unusual for new tumours to appear in other situations probably due to

some form of oversensitivity or some cancerous tendency in the oral mucous membrane.

Necroses on the basis of overdosage were also discussed and PERUSSIA considers that these are caused by an endarteritis of the vessels of the mucous membrane produced by radiation thus bringing about poor resorptive and nutritive conditions. He does not consider primary osteonecrosis probable but rather that the mucous membrane necrosis is the primary lesion which is followed by a periosteal necrosis and, as the bone is bared, by a secondary bone necrosis. He opposes REGAUD's conception »l'os se brûle lui-même et brûle les tissus environnants». The great importance of oral hygiene was mentioned as a prophylactic against necrosis and the treatment of the necroses was discussed.

The assistant reviewers were BERVEN (Stockholm), COUTARD (Paris), FINZI (London), PFAHLER (Philadelphia) and QUICK (New York).

BERVEN presented the technique and results of treatment of tumours of the oral cavity at Radiumhemmet. The principles for the treatment of the radioresistant tumours are: Teleradium treatment at a 6 cm. distance with large quantities of radium (3 and 5 grams) from a number of portals with daily doses of 6 to $7^1/_2$ gram-hours and total doses up to about 100 gram-hours. The total period of treatment covers about 3 weeks. If tumour remnants remain they are removed by electrocoagulation, sometimes accompanied by interstitial implantation of radium needles. In more radiosensitive tumours such as lymphoepithelioma and lymphosarcoma röntgen treatment suffices with local radium treatment of any eventual small tumour remnants. Of 384 cases under observation 5 years or more, 100 or 26 % are symptom-free.

COUTARD presented the well-known principles of the Coutard method and the results of treatment of 89 cases of cancer of the hypopharynx from 1921—1926. Cures of three years duration were obtained in 13 %, of 5 years in 12 % and of 7 years in 9 % of these cases. The patients who died after 3 years died of distant metastases or of intercurrent disease without having had local recurrences or regional metastases.

COUTARD gave an interesting interpretation of the well-known opinion of the Paris school as to the significance of the connective tissue and vascular apparatus in healing. The disintegration of the highly differentiated tumour cells which can take place as late as 40—60 days after the beginning of radiation is preceded by a period of transformation. If the adjacent connective-vascular apparatus is injured or modified by radiation the nutrition of the differentiated tumour cells is interfered with and thereby their radiosensitivity and the transformation which is so important for healing is unable to take place. Finally COUTARD mentioned that many factors in regard to the effect of radiation on tumour cells are still incompletely understood and that further research in this field is necessary.

FINZI from St. Bartholomew's Hospital (London) described the technique of treatment with different localizations of tumours. He considered that the radiological treatment should be spread over at least 30 days but he is not convinced that anything is to be gained by protraction of the single dose. He showed an experimental arrangement to demonstrate on the tumour whether protraction of the single dose is of importance or not. All the other factors, filter, distance, half-value layer etc. were left unchanged and only the current was varied. However no definite decision had as yet been arrived at on this question. According to FINZI's conception shorter wave lenghts should give better results than longer ones in the same case.

PFAHLER usually begins the treatment of tumours of the oral cavity with external teleradium in the form of a pack at a 4—6 cm. distance and a total dose of 30—50 gram-hours over 3—4 weeks. According to his experience a higher filtration gives a proportionally greater differential effect on the malignant tissue than on the normal, that is to say, one obtains a more satisfactory destruction of the malignant tissue and a better preservation of the normal tissues. Teleradium treatment is supplemented if necessary by röntgen treatment and by the surface or interstitial application of radium to the tumour. Small tumour remnants are removed by electrocoagulation.

The results of treatment presented by PFAHLER were very beautiful and illustrated their progressive improvement. With the earlier methods used before 1924 he had obtained an absolute 5 year cure in 24.3 % while in the material from 1924—1929 there were 27.6 % 5 year cures. The improvement was especially noticeable in regard to tumours in the pharynx where the cures had risen from 9.5 to 30 %.

QUICK (Memorial Hospital, New York) was unfortunately unable to give his paper. In his résumé however he pointed out that a conservative plan had been followed in the last 15 years in Memorial Hospital in regard to the treatment of metastases. External radiation, preferably with röntgen rays, is used and a routine block dissection is done only in the presence of clearly operable nodes.

In the sectional proceedings many other interesting papers were read only a few of which can be mentioned on account of lack of space.

LENZ (New York) described a modification of Coutard's method by varying the number of ampères, using 8 and 30 milliampères instead of 4. He felt that the biological and clinical characteristics of the tumour, its extent, infection and the invasion of bone and cartilage, play a much more important rôle in the prognosis than whether the radio-epithelitis is produced by 4, 10 or 25 r per minute. Thus prolongation of the daily dose should have no effect on the result of the treatment.

FRIEDMANN (New York) gave an interesting presentation of comparative studies on treatment with röntgen (Coutard's method), the 5 gram radium pack at a 6 cm. distance (total dose 100—120 gram-hours) and the 100 milligram radium pack also at a 6 cm. distance with continuous radiation for 18—25 days (total dose about 80 gram-hours).

MARTIN, QUICK's successor at Memorial Hospital (New York) presented their technique and results in a paper which is going to appear in full in a coming number of Acta Radiologica.

The prognosis and treatment of metastases was treated in a comprehensive paper by HOLFELDER (Frankfurt a/M). He has found that simple fractionation without protraction gives the best result. MURDOCH (Brussels) and MAISIN (Louvain) also spoke on this subject.

The indications for preoperative and postoperative radiological treatment of mammary cancer and the results of such treatment were discussed by WINTZ (Erlangen), ADAIR (New York), MELCHART (Wien) and MAISIN (Louvain). WINTZ presented a complete statistical study of his results in the treatment of cancer of the breast, stressing the great value of general hygienic and health building treatment, in that in his material 50 % better results had been obtained among the well-to-do clientel. MAISIN described a combination of radiological therapy with the use of a stabilized 1 : 10,000 solution of barium saccharate, 10 drops being given on a fasting stomach every other day for several years. ADAIR described the study in progress at Memorial Hospital of the treatment of operable mammary cancer using different methods of technique.

MELCHART reported a combination of röntgen treatment with simultaneous radium puncture.

SCHLOSS (Wien) presented a statistical report on the possibility of cure in the undifferentiated rectal cancers by means of radiological treatment alone without operation.

One part of the program was devoted to new methods of treatment. In connection with the assumption of the similar effects of long wave röntgen radiation and short wave radium radiation CHAOUL (Berlin) described his new röntgen tube for »Nahebestrahlung» and the technique of treatment. The speech was given by means of a film with running texts in German, French and English, an unusually excellent technical procedure. He had been fortunate enough to obtain primary cures in 95 % of approximately 100 cases.

Treatment with the extremely hard röntgen rays (500—800 kV) was discussed by many members including VON SCHUBERT (Berlin), SCHMITZ (Chicago), FAILLA (New York) and SOILAND (Los Angeles).

A number of papers were also given on the röntgen treatment of benign conditions, particularly inflammatory processes and on the interesting röntgen treatment of the sympathetic in different diseases.

In the biological section an extremely interesting speech was given by MIESCHER (Zurich) on biological investigations of the reaction of the skin in protracted fractional treatment and another by CUTLER (Chicago) on the reaction of normal and pathological tissues to teleradium therapy.

One fault of a great number of the therapeutic papers was the absence of a scientific, statistical analysis of the results of treatment. Usually the principles and technique of treatment were described but as a rule only the most superficial statistics were reported without any further account of the different clinical groups of the material and often with only the result of the primary healing. It was only the larger clinics which were able to report permanent results on large numbers of cases.

The gynæcological part of the program was dominated by questions dealing with the radiological treatment of uterine cancer. The reviewer for this topic, A. LACASSAGNE (Fondation Curie, Paris) presented in his interesting survey a clear orientation of the present technique of treatment and its development. In both the printed review and in the actual introductory speech it was emphasized that the most important step in the treatment of uterine cancer is still the application of radium in the uterine cavity (brachy-radium treatment). Great value is attached to the combined intra-cavity and transcutaneous treatment. At the Fondation Curie they seem to have had favorable experiences with transcutaneous teleradium treatment. They work there with a 8 gram apparatus. LACASSAGNE expresses himself more cautiously in regard to the transcutaneous röntgen treatment, a circumstance which should be kept in mind as this report comes from a clinic where the Coutard treatment has been thoroughly experimented with for a long time. There had been invited as assistant reviewers REGAUD (Paris), VOLTZ (Munich), both of whom were unable to be present, HEYMAN (Stockholm), SCHMITZ (Chicago) and WINTZ (Erlangen) who presented their treatment results. The figures from Stockholm and Erlangen show that the results with respective methods of treatment tend to become stabilized. SCHMITZ gave an account of his experience in röntgen treatment with an 800 kV instrumentarium. His cases are still too few for one to be able to form any conception of the value of this treatment. Results of treatment of uterine cancer were also presented by BENARD-GUEDES (Lissabon), OPPERT (Paris) and OSTRCIL (Prague) among others.

Sir GEORGE BUCHANAN gave a report of the further work on uterine cancer statistics which was initiated in 1928 by the Cancer Commission of the League of Nations and which had been aired on the days before the congress at a meeting where a number of experts from France, England, Holland, Belgium and Sweden had an opportunity to discuss the matter with Dr BOUDREAU, the Chief of the Hygiene Section. MCLENNAN (London) gave a report on the organization of the cancer campaign in

England and SMALLMAN (London) presented the principles for the formation of cancer statistics which are recommended by the English Public Health Authorities. Following a paper by GIBERT (Paris) on the röntgen treatment of corpus cancer and uterine bleeding in the climacterium there was an animated discussion as to the necessity of histological examination and the difficulties encountered in such an examination in cases of corpus cancer.

One of the chief topics was »Kurzwellentherapie» and SCHLIEPHAKE (Giessen) had been invited as reviewer. The co-reviewers were DAUSSET (Paris), LIEBESNY (Wien) and RECHOU (Bordeaux). This method of treatment which is still in its infancy already seems to be a good addition to the arsenal of medical treatment. Particularly good results have been obtained in the treatment of acute infections. SCHLIEPHAKE showed striking results in the treatment of lung abscesses and empyema. The method also seems to have a good effect on the arthritis. However as long as the question of dosage in this form of therapy is unsolved and as knowledge of the biological effects produced by it is no greater than at present there seems to be a factor of risk in the use of this method. A treatment given incautiously and without actual knowledge of the subject could produce profound injuries. This type of treatment should therefore only be administrated by specially trained and experienced physicians if it is not to acquire a bad reputation.

The discussion on mitogenetic radiation which had been looked forward to with great interest was a disappointment as the chief reviewer SALKIND (Leningrad) was not present. The introductory paper was given by FRIEDRICH (Berlin) who in spite of several attempts has not been able to establish the existence of the mitogenetic radiation. On account of the absence of SALKIND the speaker apparently felt that he should not present his comments in a more categorical form. The report of RAJEWSKI (Frankfurt a/M) on the same subject was of interest. He had carried out many experiments and by means of a physical method (photoelectric cell-Geiger-Müller counter) obtained positive results with several different biological objects. One should probably await further scientific results before the existence of the mitogenetic radiation may be said to be proven.

One main topic was the röntgen investigation of biological structures. The reviewers were ASTBURY (Leeds) and DEBYE (Leipzig). The methods of investigating the structure of different substances by means of röntgen interferences have reached an extraordinary state of development by the work in crystallography. The investigations of recent years with organic substances seem to show that these methods could give information as to molecular structure which would be of great importance in cellular research. Investigations of this type may perhaps

in the future lead to diagnostic methods of value for practical medicine.

The suitability of using the same physical unit of dosage in radium and röntgen treatment was the subject of one of the main discussions. Opinions on this point were very diverse. The chief reviewer HOLTHUSEN (Hamburg) considered that there was every reason for the adoption of the international röntgen unit (*r*) in the field of gamma radiation while it was pointed out by American and Swedish workers (FAILLA and SIEVERT) that measurement of the radiation dose in *r* units in gamma radiation is not yet possible, particularly when it is a matter of measuring the dose on the skin which is the most important in radiological treatment. The investigations in this field referred to by FAILLA (New York) showing the great sources of error which are still attached to the measurement of doses in gamma radiation would seem to be the most significant contribution presented at the congress for the clarification of problems in this connection.

It is worth noting that the proposal to use the *r* unit for gamma radiation originated in Germany where radium therapy with large quantities of radium is practiced only to a very slight extent. In those countries which have years of experience in radium therapy the difficulties which prevent the use of the same unit for röntgen and radium dosage have been well known for a long time and the otherwise attractive idea of uniformity in the unit of dosage of the two types of rays has in most cases been given up.

A comprehensive survey of the research in gamma radiation from the earth and cosmic radiation was given by SIEVERT (Stockholm). On account of their well known work in this sphere HESS (Innsbruck) and KOLHÖRSTER (Berlin) were selected as co-reviewers and each discussed his special field, variations in ultraradiation and the discovery and the characteristics of the hardest ultra rays. A lively discussion followed the speeches.

During the Congress the international commission for protection against röntgen and radium held a meeting at which some changes were made in the international rules of protection. In its report the commission points out among other things the great risk to the personnel and doctors who are administering teleradium treatment with large quantities of radium and expresses a desire that those who have special experience in this field should place themselves in communication with the commission. The purpose of the commission should be to prepare for the next Congress detailed instructions as to protection when using telecurietherapy.

The international committee on radiological units also had a meeting at which only relatively unessential changes were made in the precepts.

No definite decision was arrived at as to the use of the röntgen unit in the field of gamma radiation.

An extremely interesting and complete exhibition of apparatus had been arranged in the newly built functionalistic Kunstgewerbemuseum in Zurich.

Social entertainment had been provided for to the same abundant and excellent extent as the scientific. The local authorities of both Zurich and St. Moritz gave receptions the first evening the congress met in each city. The high point of the festivities consisted in a summer festival which »Lesezirkel Hottingen» had arranged with costumes, masques and national customs at the beautifully situated Hotel Dolder in Zurich. The customs of Swiss country life were presented on a large stage with bonfires and torches. The whole performance gave an unforgettable impression of the unique Swiss national life.

The proceedings of the Congress are published in four volumes, Vol. I containing list of members and portrait catalogue, Vol. II abstracts of communications, Vol. III papers on the organization of the cancer campaign and Vol. IV the final report. All of these may be obtained by applying to Kommissionsverlag Georg Thieme, Leipzig. The members of the congress received a 267-page festival volume of Acta Radiologica (Vol. XV fasc. 4—5) with contributions exclusively from Swiss radiologists and scientists in the field of physics, mineralogy, paleontology, zoology and medicine.

The closing of the Congress took place in St. Moritz on a beautiful sunny day on the open field outside the Stadium with the Alps looking down ower the assembly which was sitting unconventionally on benches and chairs and in the grass around the president and his staff who were heartily thanked for the trouble they had taken in order to make the congress so extraordinarily successful. The efficiency and courtesy of the Secretary-General, Dr H. E. WALTHER, deserve a special mention in this regard.

The next Congress will be held in America in July 1937 with Professor ARTHUR CHRISTIE (Washington) presiding. The American committee will decide later in which city the Congress shall meet.

NACHTRÄGLICHE BEMERKUNG

In meinem in dieser Zeitschrift veröffentlichten Aufsatz (Bd. 15, Pag. 89) »Über Wärmetherapie bösartiger Tumoren» fehlt die Angabe, dass die betreffende bei der Transplantation von Tumoren an Mäuseschwänze in Anwendung gebrachte Versuchstechnik auf noch nicht veröffentlichten Versuchen des Herrn Dr. JENS NIELSEN, Kopenhagen, beruht.

Kristian Overgaard.

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SUPPLEMENTARY VOLUMES

TO THE ACTA RADIOLOGICA

— Monographs on Radiological Topics —

SUPPLEMENTUM I: **Röntgenologische Studien über den Bulbus duodeni** von ÅKE ÅKERLUND (261 Seiten mit 159 Abb. im Text und 76 Abb. auf 19 Tafeln), 1921.

Diese für die Röntgendiagnostik des Ulcus duodeni grundlegende Arbeit ist *vergriffen.*

SUPPLEMENTUM II: **On the Permanency of Radiological Healing in Malignant Tumours** by GÖSTA FORSSELL (83 pages), 1928. Price bound Sw. Crowns 10: —, unbound Sw. Crowns 8: —.

While otherwise the results of radiotherapy are judged by the percentage of cases healed after a certain period, the author has tried to arrive at a new point of view for the value of radiotherapy in cancer, by investigating the permanency of the healing and the frequency of recurrences in those cases of malignant tumour where freedom from symptoms has been attained by radiotherapy.

An investigation into the permanency of radiological healing is of all the more interest, as there is a fundamental difference in the healing that takes place after the removal of a tumour by surgical intervention, and the healing process which is produced by irradiation.

The decision as to whether surgical intervention or radiotherapy should be resorted to in a certain case, will ultimately depend upon which of the two methods of treatment has the best prospects of achieving permanent healing.

The author renders an account of the permanency of primary healing, i. e. freedom from symptoms, achieved at the Radiumhemmet by radiotherapy in cases of cancer of the skin; cancer of the lip; cancer of the oral cavity; cancer of the uterus, and sarcoma, and he analyses the factors on which the radiological healing of malignant tumours seems to depend.

SUPPLEMENTUM III, PARS I (237 pages): **A Report of the Second International Congress of Radiology, held in Stockholm, 23rd—27th July 1928,**

containing lists of officers and committees, general programme, account of the official opening of the congress, description of the presidential badge, protocols for the General Assembly, for the meetings of the International Radiological Committee and for the meetings of the Executive Committee, rules and regulations for the International Congresses of Radiology and international recommendations for Roentgen-Ray and Radium Protection;

The Proceedings of the Joint Scientific Meetings of the Second International Congress of Radiology: L. JACHES, U. S. A.: Lung Suppuration; R. BALLI, Italy: Le roentgendiagnostic surtout au point de vue des organes de l'abdomen; CL. REGAUD, France: Influence du »facteur temps» sur la stérilisation des lignées cellulaires normales et néoplasiques par la radiothérapie.; R. KNOX, England: The Biological Factor as a Guide to Dosage and its Influence upon the Developments of Technique; A. REYN, Denmark: The treatment of Tuberculosis of the Skin by a Combination of Local Finsen Therapy and General Light Baths; H. HOLTHUSEN, Germany: Strahlentherapie und Immunität.

PARS II: **Abstracts of Communications at the Congress** (260 pages). Price of Suppl. III Sw. Crowns 15: —.

SUPPLEMENTUM IV: **Teaching and Training in Medical Radiology** (247 pages). Papers delivered at the Second International Congress of Radiology, in Stockholm, 1928, by representatives of 23 countries (*Austria:* HOLZKNECHT; *France:* BELOT; *U. S. A.:* HICKEY; *England:* MELVILLE; *Belgium:* MURDOCH; *U. S. S. R.:* NEMENOW; *Italy:* PERUSSIA; *Spain:* RATERA; *Switzerland:* SCHINZ; *Holland:* STEENHUIS; *Czechoslovakia:* ALTSCHUL; *Portugal:* BÉNARD-GUEDES; *Egypt:* GARDNER; *Argentina:* HEUSER; *Norway:* HEYERDAHL; *Hungary:* HOLITS; *Poland:* MAYER; *Japan:* NAKAIDZUMI; *Rumania:* NEGRU; *Denmark:* PANNER; *Latvia:* WEBER; *Sweden:* FORSSELL). Price Sw. Crowns 20: —.

In this volume the leading teachers in medical radiology throughout the world are giving an account of the organisation of the education in radiology in their native countries and are submitting criteria for its further development and improvement. The book thus constitutes a source of knowledge and impulses for the teachers and authorities who are responsible for the organisation of the tuition in medical radiology and its further improvement and development.

The different papers are printed in the language (English, French or German) in which they were delivered.

SUPPLEMENTUM V: **Catalogue des Portraits des Membres du Deuxième Congrès International de Radiologie à Stockholm, 1928.** 2ème Edition, complétée. Prix Cour. Suéd. 5: —.

The Suppl. III, IV and V, published on the occasion of the Second International Congress of Radiology, may be obtained at the price of 25 Sw. Crowns for the three volumes, by order directly to the Editorial Office of the Acta Radiologica, Stockholm 2 (Sweden).

SUPPLEMENTUM VI: **The Roentgen Diagnosis of Echinococcus Tumors** by GUNNLAUGUR CLAESSEN (155 pages with 4 figures in the text and 82 figures on 30 plates.), 1928. Price Sw. Crowns 15: —.

The work treats particularly of the cysts in the liver; thirty-seven of the forty-four cases described and commented on by the author being of echinococci located in that organ. The author shows that the subphrenic liver cyst is the one which lends itself most readily to roentgenologic examination, which is of course a great help for the surgeon. In a great many cases, the roentgenologic diagnosis rests on the calcification in the capsule surrounding the parasite, and the author shows that such calcification is far more common than generally supposed. There are striking proofs to show that many so-called lung cysts are in reality subphrenic liver cysts that have broken through the diaphragm and ruptured into the lung. The roentgenologic diagnosis is therefore indispensable for a correct organic diagnosis. The work adds two new cases of echinococcus cysts in bones to

the relatively few of that kind hitherto reported in the literature. A detailed description is given of the difficult technic of examination of cysts in the liver. The monograph further includes a review of the biology and morphology of the parasite, of the pathogenesis of the disease and of the pathoanatomical changes in the organs which are important for the roentgenologic diagnosis. Finally, a survey is given of the geographical spread of the echinococcus disease, which is considerably wider than generally supposed.

SUPPLEMENTUM VII: **Iodized Oils as an Aid to the Diagnosis of Lesions of the Spinal Cord and a Contribution to the Knowledge of Adhesive Circumscribed Meningitis** by MARTIN ODIN and GÖSTA RUNSTRÖM (85 pages with 4 figures in the text, 38 figures on 6 plates and 4 diagrams), 1928. Price Sw. Crowns 15:—.

An account is given of the normal anatomy of the subarachnoid space and of the technique previosly used in myelography with small quantities of oil by which no complete picture of the subarachnoid space is obtained. By injection of greater quantities of oidized oil this is possible. Iodized oils hitherto employed, however, in greater quantities produce severe by-effects, meningitis. The authors have succeeded in making oils much less irritant.

The method of investigation has consisted in intralumbar injection of 5, preferably up to 10 c. c. By inclining the patient in prone and supine position the oil is made to pass along the anterior as well as the posterior subarachnoid space and is followed on the screen and by series of films. The roentgenological appearance of the normal subarachnoidal space is described.

The myelographical evidence of pathological processes is a complete or partial obstruction to the passage of the oil. Above all, however, do such processes become evident by defects in the contrast shadow, who in early cases can only be registered by using this method with greater quantities of oil. Radiograms of the different pathological processes, extra- and intramedullary tumours, inflammatory changes and traumatic injuries often give characteristic appearances, which are closer described.

Myelography proves to be an important diagnostic aid, particularly valuable in the diagnosis of tumours and inflammatory changes and often completes the usual clinical methods, which, however, it can never replace. The method is not without by-effects and is to be reserved for cases where the usual neurological investigations are un able to give a sure diagnosis.

SUPPLEMENTUM VIII: **The Effect of Roentgen Irradiation on the Interrelation between Malignant Tumors and their Hosts** by CARL KREBS (133 pages with 20 figures in the text, 6 figures on 3 plates, and 20 tables), 1929. Price Sw. Crowns 8:—.

The treatise deals with the effect of the roentgen rays on the tumors and on the organism. First, a detailed description is given of primarily arisen tumors in animals, with copious references to the literature up to 1928, and a carcinoma of the breast is described, with which was done the work recounted in the succeeding chapters. A similar historical account is given of tumors arisen after tar-painting, and a sarcoma described which developed as a result of that treatment. Next, a survey is given of earlier attempts at transplantation throughout the times, and the technic of grafting employed by the author in his present researches is explained.

In the following chapters are reviewed the earlier attempts, by others, to determine the dose of roentgen required for killing neoplastic tissue by irradiating respectively in vitro and in situ, and the author's own experiments in the same direction. The dose which, both in the case of a sarcoma and a carcinoma, whether in vitro or in situ, was found sufficient to prevent a take when implantation on the animals was made immediately after the irradiation, was found to lie in the neighborhood of 6 erythema doses. In this series of experiments were employed something over 800 animals.

The next part of the work decribes the effect which preceding local irradiation of the skin has on a subsequent, either intracutaneous or subcutaneous, implantation of tumor tissue. The result of the experiments shows that under those circumstances the carcinoma, as a rule, does not take at all, or that, at any rate, the inhibition is very great. Various doses are mentioned, from which no optimum of effect was obtained; but the one required for arresting the growth is much smaller than the one required for killing the tumor, — namely, 1 to 2 erythema doses. The effect is strongest when the implantation is not done until some time — twenty-four hours — after the skin has been irradiated.

Finally, it is shown that when the sarcoma is implanted in irradiated tissue the energy of the neoplastic tissue's growth is demonstrably reduced, while the proportion of takes does not become less, nor is there apparently any lengthening of the duration of the animal's life.

Both in the first chapter and in his concluding passages the author draws a comparison between the conditions thus observed and the observations made in the after-treatment of cancer mammae.

SUPPLEMENTUM IX: **Experimental Studies on Roentgen Treatment of Malignant Tumors** by JENS JUEL (104 pages with 1 figure in the text, 4 figures on 2 plates and 21 tables), 1929. Price Sw. Crowns 8:—.

The purpose of the studies is to try by irradiation of transplanted tumors in mice to find some guiding lines for the Roentgen therapy, the studies being aimed in particular at the significance of the dosage in local irradiation, of universal irradiation and of fractionation of the dose. It has been possible to investigate these questions in a relatively uniform material of considerable size (ca. 1600 animals) under experimental conditions varied accordingly.

On local irradiation with increasing doses there was a fairly gradual increase in the effect — up to twice the epilation dose, *i. e.*, a dose which caused a rather serious injury to the normal tissues. Universal irradiation with doses of $^1/_{80}$—$^1/_3$ epilation dose had only a slight effect on the tumor, and might even lower the resistance of the animals. The radiation effect was found to be of decidedly local nature.

Fractional irradiation showed in all cases, varied in different ways, a smaller effect than obtained with a single application of the same total dose. Like most other growing tissues, then, the tumors showed an incomplete cumulation of the partial doses. If, on the other hand, fractional irradiation and single-exposure irradiation were given in different doses, adjusted so that the skin effect (estimated by the degree of epilation) was the same after either manner of irradiation, the tumor effect of fractional irradiation was found to be considerably greater than that of a single exposure. Thus it was possible to demonstrate an increase in the elective effect of irradiation with a fractional dosage, as the cumulation of the divided doses in the skin was even more incomplete than the cumulation in the tumor. Therapeutically, therefore, the fractional irradiation is to be preferred, as here the point is to obtain the greatest possible difference in the effect on the tumor and on the normal tissues. — Under the given experimental conditions, distribution of the divided doses after the saturation principle was found to have a more favorable effect than the simple fractional method.

SUPPLEMENTUM X: **The Origin of Lymphosarcomatosis and its Relation to other Forms of Leucosis in White Mice** by CARL KREBS, H. C. RASK-NIELSEN and AAGE WAGNER (53 pages with 29 figures on 15 plates and 8 tables), 1930. Price Sw. Crowns 8:—.

A communication concerning a lymphoid tumor and its relation to leucosic changes. The opening paragraph deals with the lymphatic tumors and transmissible forms of

leucosis in mammals described in the literature, and the use of which they have been for the study of leucosis. As spontaneously arisen mediastinal, lymphatic tumors were not altogether rare in the laboratory of the authors, transplantation of these was attempted, but succeeded only when the implantation was made on animals that had previously been subjected to strong general irradiation with roentgen. It was found that lymphoid tumors occurred with greater frequency in animals that had been exposed beforehand either to such treatment or to strong local irradiation. The above mentioned, spontaneously arisen tumor was found in an animal that had previously been irradiated on the hind part of the body with 3 erythema doses filtered through 5 mm. of aluminium.

The tumor is still alive, and has been kept so for the last five years. Its macroscopic and microscopic appearance, and the manner of its growth, are described. The leucosic changes that take place spontaneously and in roentgen-treated animals in whom tumor tissue has been implanted are discussed. The spontaneously arisen pathologic condition, as well as the one artificially induced, takes the pathoanatomical form variously of lymphadenosis and lympho- or leucosarcomatosis. There is much to indicate that the disease is closely related to the leucosis in man.

On the basis of their own researches, and of the descriptions elsewhere given of tumor forms of a similar character, the authors discuss the question as to how the growth observed by them should properly be rubricated. They believe it to be a lymphosarcoma, and suggest that the disease described should be called: *lymphomatosis infiltrans (leucemica et aleucemica)*.

To the communication are appended extracts from laboratory journals, photographs, microphotographs and a list of literature related to the subject.

SUPPLEMENTUM XI: **Malignant Tumours of the Tonsil, a Clinical Study with Special Reference to Radiological Treatment** by ELIS G. E. BERVEN (285 pages with 10 figures in the text, 45 coloured illustrations and 36 tables), 1931. Price Sw. Crowns 22:—.

The work is a monograph on the malignant tumours in the palatal tonsil and on their treatment, particular consideration being taken to the radiological therapeutic technique that has been elaborated at the Radiumhemmet, and which, on principle, is still in use for the treatment of malignant tumours in the oral cavity and throat.

The author gives a detailed description of the symptoms of malignant tonsillar tumours, and lays especial stress on the early symptoms and the differential diagnostic problems at an early stage, which are of the utmost importance for the prognosis in these rapidly growing tumours which form metastases at an early stage. A meticulous account is rendered of the histological structure of the various tonsillar tumours.

The work is a careful and thorough account of the therapeutical technique employed, of the course of healing, and of the results of treatment.

A great improvement in the results from treatment has been achieved since the teleradium treatment has been introduced on a large scale. With this technique freedom from symptoms for over 3 years has been obtained in 28.6 percent of the cases. Of the four cases of lymphoepithelioma observed more than 3 years after treatment, 3 are still living free from symptoms after respectively 3, 4 and 5 years.

In the case of sarcoma, very good therapeutic results have been obtained, in that 42.8 % are living free from symptoms for 3 years or more.

A comparative synopsis is given of methods of treatment and results of treatment, elaborated and obtained at other radiotherapeutical clinics.

Clearly and distinctly drawn up tables of the material and the therapeutic technique in every case, as well as of results obtained, have been rendered, which permit of rapid orientation as regards all details of treatment. Futhermore, there are rendered the clinical facts contained in a separate chapter.

SUPPLEMENTUM XII: **Apparatus and Technique for Roentgen Examination of the Skull** by ERIK LYSHOLM (120 pages with 102 figures in the text and 36 figures on 36 plates) 1931. Price Sw. Crowns 25:—.

In the first part of the book is rendered a description of the Lysholm-Table, with numerous illustrations. For the making of typical and special pictures of the skull, this apparatus is of great benefit. It enables precise adjustment, not only from below by means of a mirror, but also from above by means of an indicator of the central ray. The tube always moves in a hemisphere with the centre in the plane of the film, that is, the point seen in the mirror device. In this way it is possible to repeat precisely the same exposure. A change of angle of 3° corresponds to a linear movement of 7 cm., a fact which facilitates the making of stereoscopic pictures. Primary and secondary diaphragms are delineated and described, and the theoretical bases, as well as their practical application and use, are explained. The author also describes a secondary diaphragm designed by himself, with a depth of only 2 mm. The lamels of the diaphragm have a thickness of 0.04 mm., and there is an interstice of only 0.04 mm. between them. This design enables the taking of sharp and clear radiographs, not only with a perpendicular direction of the central ray but also with oblique incidence.

In the second part of the book there is rendered a detailed account of sundry special projections in the roentgenography of the skull. All projections of importance are to be found there, and the adjustment of the apparatus is described briefly and clearly. The description of every projection is accompanied by corresponding roentgenograms together with explanatory sketches, so that by means of the same one can at once decide if an exposure has been technically successful or not.

SUPPLEMENTUM XIII: **Röntgenologische Beobachtungen über die Bewegungen der Wirbelsäule** von SIGVALD N. BAKKE (75 Seiten mit 4 Fig. im Text, 45 Fig. auf 14 Tafeln und mehreren Tabellen), 1931. Preis Schw. Kronen 10:—.

Unter kritischer Berücksichtigung der einschlägigen Literatur gibt der Verf. einen eingehenden Bericht über seine anatomischen Untersuchungen betreffs der Bewegungen der Wirbelsäule.

Seine Untersuchungen haben gezeigt, dass die Biegsamkeit die ganze Kolumna entlang von Wirbel zu Wirbel gleichmässig ab- und zunimmt. Nirgends finden sich inflexible Partien zwischen den flexiblen. Dies gilt sowohl von Vorwärts- und Rückwärtsbeugungen als von Seitenbeugungen. In der Halswirbelsäule findet sich die grösste Beweglichkeit zwischen dem V. und VI. Wirbel. Die Totalflexibilität beträgt durchschnittlich 20°, und zwar überwiegt die Dorsalflexion bedeutend die Ventralflexion. An der Brustwirbelsäule findet sich die grösste Beweglichkeit zwischen dem I. und II. Wirbel, ca. 10°, je etwa 5° Dorsal- und Ventral-flexion. Im Gegensatz zu der Halswirbelsäule ist die Rückwärtsbeugung der Brustwirbelsäule geringer als die Vorwärtsbeugung. Die letztere nimmt aber allmählich nach den unteren Teilen etwas zu. Im ganzen aber ist in diesem Teile der Wirbelsäule die ventrale Flexibilität grösser als die dorsale Gesamtflexibilität. Die Biegsamkeit der Lendenwirbelsäule erreicht zwischen dem IV. und V. Wirbel ihr Maximum, 13°. Noch grösser ist sie aber ausserhalb der Lendenwirbelsäule, im Lumbosacralgelenk, wo die Flexibilität 23—24° betragen kann. Die Gesamtflexibilität der Lendenwirbelsäule ist 70°. Die Dorsalflexibilität ist überwiegend. Betrachtet man die gesamte Wirbelsäule, so beträgt die Vorwärtsbeugung 78.6° im Durchschnitt, die Rückwärtsbeugung 140.4 im Durchschnitt, Totalflexibilität 219°.

Auch für die Seitenbeugung findet sich eine über die ganze Wirbelsäule sich erstrekkende Biegsamkeit. In der Halswirbelsäule findet sich die grösste Seitenbeugung vom III. bis zum V. Halswirbel, wo die etwa 6° betragen kann. Die gesamte Seitenbeugung der ganzen Halswirbelsäule ist ungefähr 23°. In der Brustwirbelsäule ist die Seitenbeugung auf diesen ganzen Abschnitt fast gleichmässig verteilt und beträgt etwa 2—3°. Die gesamte Seitenbeugung der ganzen Brustwirbelsäule ist 30.6°. In der Lendenwirbel-

säule findet sich die grösste Seitenbeugung zwischen dem II. und V. Wirbel, wo sie 7° bis 8° betragen kann. Die gesamte Seitenbeugung der ganzen Lendenwirbelsäule ist 24.3°. Die gesamte Seitenbeugung der ganzen Wirbelsäule mag zwischen 75—80° variieren.

SUPPLEMENTUM XIV: **Eine Methode zur Messung von Röntgen-, Radium- und Ultrastrahlung nebst einige Untersuchungen über die Anwendbarkeit derselben in der Physik und der Medizin** von ROLF M. SIEVERT (179 Seiten mit 154 Abb. im Text, 17 Abb. auf 8 Tafeln und mehreren Tabellen), 1932.

Die Arbeit enthält eine eingehende Beschreibung der nach dem vom Verfasser im Jahre 1926 beschriebenen Kondensatorprinzip der Ionisationsmessung entwickelten »Kondensatorkammermethode», die speziell für Messungen in der medizinischen Radiologie wesentliche Vorteile gegenüber den früheren Methoden besitzt. Sowohl die theoretischen wie auch besonders die praktischen Grundlagen der Methode werden behandelt und eine grosse Menge von nach der Methode ausgeführten Messungen verschiedenster Art geben ein deutliches Bild über die Eigenschaften der Methode.

Für Messungen in der medizinischen Radiologie hat die Methode neue Möglichkeiten geschaffen. So gestattet sie Ionisationsmessungen sowohl auf der Oberfläche wie im Innern des Körpers, mit sehr kleinen kugel- oder nadelförmigen Kammern, ohne dass irgendwelche empfindliche Instrumente während der Bestrahlungen benutzt zu werden brauchen. Auch werden einige Messungen des Strahlenschutzes an Personen in radiologischer Tätigkeit angeführt, bei denen kleinen, kugelförmigen Kondensatorkammern mit einem Diameter von 10 mm benutzt wurden. Von besonderem Interesse ist, dass Messungen in der Weise gemacht werden konnten, dass nach dem Auslande solche Kugelkammern in geladenem Zustande hinausgeschickt wurden und nach Bestrahlung und Zurücksendung die Dosen, denen die Kammern ausgesetzt waren, bestimmt werden konnten. Trotzdem die Zeit zwischen Ladung und Ablesung der übriggebliebenen Ladung in einigen Fällen 1 bis 2 Monate betrug, sind doch Messungen mit einem maximalen Fehler der Grössenordnung 2—3 % möglich.

Einige rein physikalische Arbeiten über die Ionisation bei hohen Drucken, Absorption der gamma-Strahlung und die Anwendung der Methode zur Messung von Ultrastrahlen, die insgesamt die Empfindlichkeit und Genauigkeit der Methode veranschaulichen, werden auch beschrieben.

Ausserdem enthält das Buch eine Anzahl von Vorschlägen für die weitere Entwicklung der Kondensatorkammermethode. Am Schlusse werden einige Tafeln über Funktionen gegeben, die für die Berechnung von Strahlungsintensitäten, besonders in der Medizin, von Wert sind.

SUPPLEMENTUM XV: **A Study of the Ionization Method for Measuring the Intensity and Absorption of Roentgen Rays and of the Efficiency of Different Filters Used in Therapy** by ROBERT THORÆUS (88 pages with 40 figures and diagrams and 23 tables), 1932.

A detailed description of the roentgen ray generating outfit is submitted. The running constancy and duplication accuracy in the production of the radiation are estimated and experimentally tested. Different conditions for the employment of the ionization method for measurements in *r*-units of the radiation intensity are discussed. A cylindrical standard chamber for measuring the air-ionization is described, and the accuracy of the measurements is considered. Different tests and calibrations are reported.

The roentgen ray absorption in Al, Cu, Sn, Sg, Pb and water is experimentally measured for some different voltages. The secondary standard used for measurements and calibrations at the different roentgen therapy departments is briefly described. A more detailed record of its properties as compared with the standard chamber is given. The

absorption and filtering properties of different materials are discussed. On the basis of the absorption of monochromatic rays the equivalence between filters of different materials is investigated. The filtration economy is discussed and some general conditions for obtaining suitable filters are given. The construction and properties of a tin-filter are submitted.

Measurements of the intensity distribution in water phantoms are discussed. On the basis of the measurements of the true absorption in water, that part of the total intensity which is due to back-scatter is calculated.

SUPPLEMENTUM XVI: **Der Wert der Röntgenuntersuchung in der Lungendiagnostik. Ein röntgenologisch-anatomischer Vergleich** von TORLEIF DALE (111 S. mit 57 Fig. auf 29 Tafeln), 1932. Preis Schw. Kronen 10:—.

Den Grundstock dieser Monographie bilden die vergleichenden röntgenologisch-pathologisch-anatomischen Untersuchungen der Lungen, die von dem Verf. in einem Zeitraum von 3 Jahren vorgenommen wurden. Er ging dabei im wesentlichen so vor, dass die am Lebenden und post mortem gemachten Aufnahmen der herausgenommenen und mit Luft aufgeblasenen Lungen und das Ergebnis der Sektion mit diesen letzteren in Beziehung gebracht wurde. Alle wichtigen und noch strittigen Fragen der Thoraxdiagnostik, wie die Frage des Zustandekommens der Körnelung bei der Miliartuberkulose, der Ringschattenbildungen, die Rolle der Atelektase bei der Deutung von Verschattungen u. a. m. werden erörtert. Die verschiedenen Verlaufsformen der Tuberkulose stehen im Vordergrunde. Aber auch die Lungenbilder bei der Bronchopneumonie, bei Bronchiektasien, Lungenabscessen, Lungencarcinom werden eingehend an der Hand von Eigenbeobachtungen besprochen. Der Bericht ist ergänzt durch eine kritische Übersicht über die bisher vorliegenden röntgenanatomischen Vergleichsuntersuchungen der betreffenden Krankheitsgruppe. Die Monographie enthält eine Fülle von Einzelbeobachtungen und -erfahrungen, wie sie nur durch die dauernde Kontrolle der Röntgenbilder mit ihrem pathologisch-anatomischen Substrat gewonnen werden können und unbedingt notwendig sind, wenn der Gefahr, bei der Beurteilung von Röntgenaufnahmen der Phantasie allzu grossen Spielraum zu lassen, wirksam begegnet werden soll.

SUPPLEMENTUM XVII: **A Roentgenological Study of Acute and Chronic Otitis media** by GÖSTA RUNSTRÖM (88 pages with 30 figures and diagrams and 54 Tables), 1932. Price Sw. Crowns 20:—.

An account is given of the anatomy of the temporal bone and its variations and the developments of the cellular system and of the different types of pneumatization. Furthermore a critical review of the roentgen technique previously used.

The author's technique is based on using the apparatus for roentgen examination of the skull devised by Lysholm (Acta Rad. Supplement XII) and a detailed description is given of the technique employed. The importance of steroescopy with utilization of the orto- and pseudoscopical picture is emphasized. A magnifying stereoscope is described. 4 stereoscopic projections are used and with diagrams a detailed roentgenanatomy of the temporal bone such as it appears in the projections employed is given.

The conclusions are based upon a clinical material of about 1000 cases and are illustrated of 47 cases with clinical histories, operation findings and 54 stereoscopic skiagrams. According to the roentgen findings the cases are divided in 7 groups.

In recording the changes observed in the radiogram the chief object has not been to make clinical or histological diagnosis. Since changes in the calcium content, contours, etc. may be caused by different pathological processes, the author has considered it of greater importance to give a careful description of the roentgen-anatomical and -pathological appearance.

SUPPLEMENTUM XVIII: **Reliefstudien an der normalen und krankhaft veränderten Speiseröhre** von RICHARD SCHATZKI (149 Seiten mit 159 Abb. auf 32 Tafeln), 1933. Preis geheftet Schw. Kronen 20:—, geb. Schw. Kr. 23:—.

Der Verf. hat sich gemäss der Arbeitsaufgabe, die er sich gestellt hat, auf ein Studium des Schleimhautreliefs mittels der Methode der dünnen Schicht beschränkt, lässt aber anderseits die durch Ausdehnung des Lumens hervorgerufenen Bilder voll zu ihrem Recht kommen. Die Arbeit bringt einen auf umfassende Literaturstudien und eingehende eigene Beobachtungen gegründeten Überblick über die normale und pathologische Röntgenanatomie des Ösophagus, wie sie beim Studium des Schleimhautreliefs hervortritt. Die Arbeit erörtert die Indikationen der Schleimhautdiagnostik und deren Vorteile bei Untersuchung des Ösophagus, aber auch die Grenzen und Fehlerquellen dieser Diagnostik, und teilt mehrere neue Ergebnisse betreffs Technik und Diagnostik mit. Verf. gibt eine Darstellung von der Bedeutung der zielbewussten Technik für die Reliefdiagnostik und zeigt, dass diese Diagnostik bei der von ihm angewendeten Technik für die Untersuchung des Ösophagus nahezu denselben Grad von Sicherheit erreicht, der bisher nur betreffs des Magens und Kolons erreicht worden war. Den Schwerpunkt der Arbeit bildet indes die Darstellung der Röntgendiagnostik der Ösophagusvarizen.

Die zahlreichen und vortrefflich ausgeführten Bilder, die diese Monographie illustrieren, bewirken, dass sie auch die Aufgabe eines übersichtlichen und reichhaltigen Atlas erfüllt, in dem sich der Praktiker rasch die Resultate der Spezialforschung zunutze machen kann.

SUPPLEMENTUM XIX: **Über die Wirkungen der Röntgenstrahlen auf die Lungen** von ROLF BULL ENGELSTAD (94 Seiten mit 35 Abb. auf 18 Tafeln und 11 Tabellen), 1934. Preis Schw. Kronen 10:—.

Nach einem Überblick über die bisherigen Publikationen, welche die nach Röntgenbestrahlung auftretenden Lungenveränderungen bei Menschen und Tieren behandelt haben, legt der Verf. die Resultate einer umfassenden Reihe tierexperimenteller Untersuchungen über diese Fragen vor. Die Entwicklung der Reaktion der Lungen ist genau studiert geworden, und hierbei wurde eine recht charakteristische Entwicklungskurve gefunden, die mit der Entwicklung der Hautreaktion eine augenfällige Übereinstimmung zeigt. Weiter wurde die Abhängigkeit der Lungenveränderungen von der Grösse der Dosen — in Verhältnis zu anderen biologischen Reaktionen, speziell der Hautreaktion — näher untersucht, zugleich mit besonderer Rücksicht auf den Einfluss der Strahlenqualität und der Bestrahlungsintensität. Die Arbeit enthält auch eine Analyse der Radiosensibilität der verschiedenen Zellen und Gewebe der Lunge. Besonders wird das Verhalten der Gefässe und Kapillaren besprochen. Das Material wird auch zur Diskussion einzelner spezieller histologischer und histopathologischer Fragen benutzt.

SUPPLEMENTUM XX: **Röntgenologische Studien über die traumatischen und habituellen Schultergelenkverrenkungen nach vorn und nach unten** von IVAN HERMODSSON (171 Seiten mit 15 Abb. im Text und 111 Abb. auf 15 Tafeln), 1934. Preis Schw. Kronen 9:—.

Die Arbeit behandelt in erster Linie die bei Schultergelenkverrenkungen vorkommenden Knochenverletzungen am oberen Humerusende. Verf. hat eine spezielle Technik ausgearbeitet, mit deren Hilfe man mit nur wenigen Röntgenaufnahmen sich ein gutes und zuverlässiges Bild der eventuell vorliegenden Veränderungen schaffen kann. Vor allem muss hierbei eine neue Art von Projektion, die »Tangentialprojektion des Humeruskopfes» erwähnt werden. Mit dieser Technik ist es dem Verf. gelungen in einer Reihe von Verrenkungsfällen typische, bisher nicht bekannte intraartikuläre Frakturen am Gelenkkopf festzustellen. Die Fraktur des Tub. majus ist in dieser Arbeit ganz be-

sonders eingehend behandelt und untersucht worden, und es hat sich dabei ergeben, dass die bisher geltenden Theorien bezüglich ihres Entstehens unrichtig gewesen sind.

Mit den neuen Untersuchungsergebnissen als Ausgangspunkt unterzieht der Verf. die alten Theorien über Verrenkungsmechanik eingehender kritischer Prüfung und weist dabei die Unhaltbarkeit einer Reihe bisher allgemein geltender Lehren nach. Ferner diskutiert er die Ursachen zu den habituellen Luxationen, wobei u. a. die Altersverhältnisse statistisch beleuchtet werden. Endlich folgt eine kurze Besprechung des Röntgenbildes bei Arthritis deformans im Schultergelenk.

The supplementary volumes of the Acta Radiologica may be ordered through the *Editorial Office of the Acta Radiologica, Stockholm 2* (*Sweden*) or through the booksellers.

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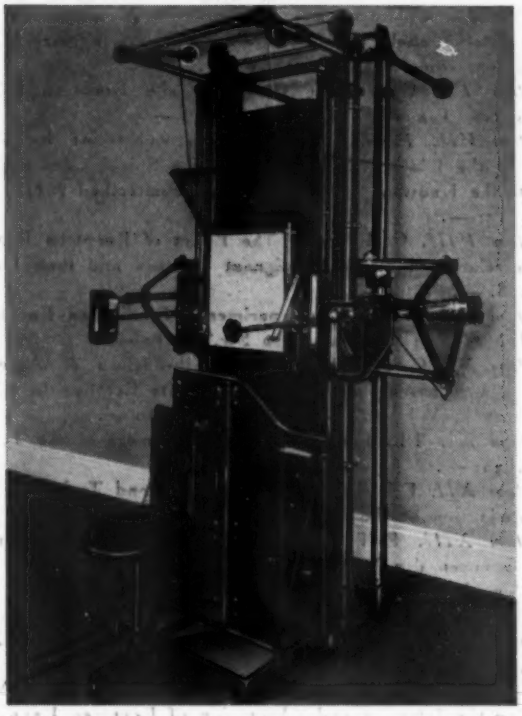

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